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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 89

English View of American Gas Rate Regulation—The Doherty Denver Gas School—Notes.

Recent Patent Issues 90

Twenty-ninth Annual Meeting, Western Gas Association—Official Report—Revised by the Secretary—Continued from page 55 90

Second Day, Morning Session—Discussion on Mr. Fred Bredel's Paper—Report of the Committee on President's Address—*The Engineering of Illuminntion, by Mr. Van Rensselaer Lansingh—Discussion—Second Day, Afternoon Session—Report of the Library Committee—Report of the Committee on Municipal Ownership.

*Increased Use of Illuminating Gas in the Industries, by "Traveller" 101

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 101

St. Louis Fails to Connect—Pottsville Sold—Lucky Tuttle—Charlottesville for Sale or Lease—Kerr Murray Busy—Opposition at Wilmington—Hanover's New Company—Cramer Retires, Williams Succeeds—Jackson's 90-Cent Rate—Explosion at San Antonio—Waterbury has New Assistant Superintendent—Matteawan Company Sold—Lapeer Company Incorporated—Milwaukee Wants More Water Gas—And Many Other Items.

The Market for Gas Securities 103

BRIEFLY TOLD.

ENGLISH VIEW OF AMERICAN GAS RATE REGULATION.—The following interesting view of gas rate regulation and legal customs in America, appeared in the *Gas World*, June 16, 1906:

It is very remarkable how exceedingly vexed a question that of the State regulation of gas charges is in America. For some reason which has never been clearly stated, the idea of such regulation in the United States has never risen above the ancient method of assizement, once common in England, and still operating, as regards the price of bread in France. Thus, after a most tremendous investigation by the New York State authorities of the affairs of the New York city gas companies, a law was enacted fixing the selling price of gas at 80 cents per 1,000 cubic feet. The companies charge was $1. This simple way of settling the question might as well have been decided upon by those who had the power of ordering the matter, as the result of 5 minutes consideration in the mayor's parlor, or wherever the city's business is done. It smacks of feudalism, carrying one's reflection back to the good old days of the "simple plan, that they should get who have the power, and they should keep who can." It never seems to strike anybody concerned that an assize of gas is as curious an anachronism as an assize of bread or ale. Yet, doubtless, when your Americans go to Paris and observe in the bakers' shops the official notification of the prices at which household and fancy loaves must be sold, they proudly imagine that in comparison with the commercial system of the United States, that of the French Republic is a "back number." Now, an assize of prices is all very well so long as it can be enforced. In the case of the New York gas charge, this has, so far, proved to be impracticable. The afflicted gas companies simply made their complaint in the Circuit Court, and the judge forthwith granted a temporary injunction restraining the State and city from enforcing the price as enacted. Consequently, the whole question has to be gone into again for the satisfaction of the Court. It is confidently predicted in the technical journals that it will take years to finish this litigation. After all, an appeal will lie to the Supreme Court against the competence of the State Legislature to pass such a law, being in contravention of the constitution of the United States. What a paradise for lawyers that land of freedom must be! *Vogue la galère!* It would be a thousand pities to stop the procession, otherwise it can scarcely be a task of insuperable difficulty, once the illusory principle of assize is abandoned, to devise a plan of regulating price by the dividend on a fair capitalization. The actual position is a fiasco of the first water—if so nice a "derangement of epitaphs" is permissible where the language of common sense seems inappropriate.

THE DOHERTY DENVER GAS SCHOOL.—The Denver (Col.) *Republican* says: "A class of young men, all of them engineering graduates of prominent universities, will begin their course in a "school of practice" in Denver this week. The school is the idea of Henry L. Doherty, President of the Denver Gas and Electric Company, and the Company will be the school. Among the 20 men are a number that have made records as athletes. Following are the names of the men, together with the colleges from which they have just graduated: W. J. Bertke, Wisconsin; T. H. Johnston, Purdue; A. L. Holter, Purdue; Matt. Derge, Wisconsin; F. L. Blackburn, Purdue; L. G. Coleman, Missouri; W. D. Masterson, Cornell; J. L. Meyforth, Michigan; R. T. Craigo, Wisconsin; W. J. Hampton, Purdue; R. M. Sargent, Massachusetts Institute of Technology; John Blatherwick, Dartmouth. Two years will be spent by the men in their training with the Denver Company. They will be fitted at the end of their course for any kind of executive position. They will be in demand immediately, and should have success from the start of their activity after their training. At the start the men will each enter one of the departments. They will spend some time where they start, then will go to another department, until they have had actual experience in them all. They may be putting coal under a boiler this week, and two years hence the head of a company employing many men to heave coal and to do other things. Not only will they have practice in building and installing machinery for generating gas and electricity, but they will know all of the other sides of the business. They will know how to lay gas mains and to build electric lines. They will know how to test everything. Their knowledge will include all of the office work. They will learn how to sell a gas range or other appliances. Last, but not least, they will know how to give the best gas and electrical service from the viewpoint of the consumer. Men trained in the Denver Company have gone with other companies in all parts of the United States. Within the last three months at least a half dozen have been sent to other companies, all of them taking positions that were better. But these men have been trained usually in only one department. The men now entering the

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"School of Practice" will have a complete training in all departments, and therefore, will be able to handle the entire property or to care for any part of it. Such men are in constant demand. Denver will supply them. They will get their training here. Other companies, aside from the large number in which Mr. Doherty has an interest, are constantly demanding men from the Denver Company, which has a standing second to no gas or electric company for enterprise and the best of everything. The school will be a permanent Denver institution. Each year a number of men will be selected from among the graduates of the big colleges. They will be brought to Denver and given a starter in the big training school that is an actual success on a large scale. These men will be trained along the lines developed by Mr. Doherty through many years. They will apply their knowledge to practice as he practices, and they will become prominent in the gas and electric world."

NOTES.—

THE Rotary Meter Company, of 280 Broadway, N. Y., which published a few weeks ago a handsomely illustrated catalogue of this novel device, informs us that over 300 have been installed abroad for the measurement of both coal and water gas, with capacities varying from 1,500 cubic feet per hour to 500,000.

THE United Gas Improvement Company has been awarded a contract for the installation of an 11-foot water gas apparatus at Washington, D. C.

THE St. Louis Gas Construction Company, of St. Louis, Mo., has recently completed bench installations at Boonville, Mo., Wooster, O., Albion, Mich., and Chatham, Ont.

THE Rutland Railway, Light and Power Company, of Rutland, Vt., is laying 3 miles of new mains in anticipation of a large increase of business.

MR. ALBERT J. WEBER, President of the Adam Weber Sons Company, reports great activity in the bench business, and has personally secured contracts of importance for bench work at Altoona, Pa., Malden, Mass., East Boston, Mass., Little Falls, N. Y., Princeton, N. J., Bath, N. Y., Bangor, Me., Newark. N. J., and Charlestown, Mass. He reports the 80 through benches of 8's as progressing satisfactorily at Cambridge, Mass.

THIS is the fiftieth anniversary of the discovery by Dr. William Henry Perkin, the eminent Englishman, of the move color obtained from coal tar, also of other colors of the spectrum. Dr. Perkin in his sixteenth year entered the Royal College of Chemistry in London, and 2 years later became assistant to Prof. Hoffman. The development of the coal tar industry by Mr. Perkin has given employment to armies of graduate chemists and engineers and workmen throughout the United States, England, France, Germany and Austria, etc. He arrives in New York in October and it is hoped that he will be here during the first meeting of the Gas Institute, which will probably emphasize his presence in an official manner. The gas engineers and the Chemical Society of London are going to honor Dr. Perkin in befitting ways.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by Royal E. Burnham, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 10 cents.

824,092. Process of extracting ammonia from gases. Rudolph Brunk, Dortmund, Germany.

824,180. Gas stove. C. H. Hoffstetter, Erie, Pa.

824,308. Gas burner. H. W. O'Dowd, New York city.

820,337. Gas generating furnace. Charles A. Buzzel, Newburyport, Mass.

824,338. Gas heating apparatus. Augustus C. Carey, Boston, Mass.

824,353. Gas producer. Heinrich Gerdes, Berlin, Germany, assignor to American Suction Gas Producer Company, Lansing, Mich.

824,358. Suction gas producer. Eugene Higgins, Lansing, Mich., assignor to American Suction Gas Producer Company, same place.

824,359. Gas producer. Robert Hilbrecht, Lansing, Mich., assignor to American Suction Gas Producer Company, same place.

824,384. Gas producer. Erich Sandner, Lansing, Mich., assignor to American Suction Gas Producer Company, same place.

824,413. Gas regulator. George E. Crookshank, Indiana, Pa., assignor of ½ to Kate Crookshank, same place.

824,419. Prepayment attachment for gas meters. Rudolph L. Fersenheim, New York city.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONTINUED FROM PAGE 55.]

THE TWENTY-NINTH ANNUAL MEETING, WESTERN GAS ASSOCIATION.

HELD IN CLEVELAND, O., MAY, 16, 17 AND 18, 1906.

SECOND DAY—MORNING SESSION.

Discussion on the Paper, Firing of Retort Benches by Battery Producers, by Mr. Fred. Bredel, Milwaukee, Wis.

The President—You have heard the presentation of Mr. Bredel's paper. Mr. Baehr.

Mr. Baehr—I have read Mr. Bredel's paper with interest. I was asked to prepare a discussion upon it, but it is very difficult to do so for two reasons—first, my knowledge of the subject is extremely limited, and secondly, I think the paper is somewhat disappointing, inasmuch as the subject is covered by a number of general statements which may be interpreted variously, and there seems to be an absence of figures upon which to base estimates of value. The centralized production of heat afforded by a producer plant certainly appeals to me very much. I might give you a mass of figures based upon theoretical considerations, but these would have very little value, because I have never actually operated, nor have I had access to a plant of this kind, and also because the latest developments in thermo-chemistry indicate that we know very little of the relations of the chemical reactions and temperature, as well as very little about the specific heat of gases. For instance, chemical reactions which are possible and do occur within certain temperatures, are reversed or only take place fractionally at other temperatures, or *vice versa*, and the indications concerning the specific heat of gases are such that it seems as though the less said at present the better. I have great hopes, however, that the near future will reveal considerable improvements in gas producers. They certainly afford opportunity for the more complete utilization of certain theoretical advantages which I have mentioned in my paper, read at the meeting of the Ohio Gas Light Association in March, 1903. I might add that I believe the time is not far distant when the broad principle of utilizing the maximum amount of heat available from retort house installations will be much more carefully carried out than at present. I refer to such items as the sensible heat of producer gas, the sensible heat of the waste gases, the reduction or partial utilization of radiant heat, the utilization of the sensible heat of the coke now lost in quenching, etc. Furthermore, such considerations as the avoidance of clinkers, the loss of heat due to opening mouthpieces, opening filling and ash doors, preheating producer fuel, more uniform heat production, and finally the possibilities of obtaining such fireclay materials as will permit operating at much higher temperatures, will all in time be worked out on scientific principles. At present, however, I will not presume to pass judgment as to the relative merit of the heat possibilities in producer versus individual bench generator installations.

Mr. H. A. Carpenter—Mr. President, any calculations which I have had occasion to make in connection with this question, have resulted in favor of each bench of retorts constructed with its own producer. There has been considerable opportunity for improvement in the efficiency of such small producers and some of the advocates of the battery plan, in discussing the subject, have made comparisons with the most inefficient and apparently badly operated individual bench producers. The size of the individual bench producer is a factor in this problem, and the tendency in large plants to build benches of much greater gas making capacity than formerly, with correspondingly large producers, will tell in favor of the individual bench producer plan.

The President—We have a contribution from Dr. Harrop, which I will ask the Secretary to read.

Dr. Harrop (read by the Secretary)—I think Mr. Bredel paid a compliment to my "knocking" ability when he went to the trouble of ascertaining that I was not committed to a belief in battery producer firing before asking me to discuss his paper. After receiving a copy of the paper and following out his argument, several points occurred to me on which I felt that I should have to claim the right to change my mind. The suggestion he made to drop the term "isolated generator firing" and adopt as a substitute for it the name battery producer is not half bad. I must own to a personal distaste for the word "generator" in connection with retort benches, for I think it does ample duty in covering the machine used to generate blue water gas, although Mr. Bredel uses the word generator frequently in relation to bench furnaces. To the application of battery producer firing in the retort house he objects: (a) It is not at all suitable for the small works because of the prohibitively large expense of installation. (b) The use

of cold fuel means a loss of 10 to 15 per cent. (c) The heat lost due to firing with cooled gas is 10 per cent. This is fair, if we admit of some latitude in the estimates of the constants. He objects further: (d) The loss of heat due to opening the filling and clinkering doors of a bench furnace should be less than 5 per cent., and not enough to credit to the advantage of Battery Producer Firing. I am afraid this is a low figure, though it must be a matter of opinion. (e) With "good coke," clinkering of a bench furnace only has to take place every 4 or 5 days, and the loss and extra labor is only slightly greater than with a battery producer plant. This is certainly better than average practice. The point I wish to emphasize is that we do not always make good coke, and moreover that there are certain large earnings possible if we will be satisfied with a markedly inferior coal. (f) The uniformity of producer gas from a bench furnace is subject to the same influences as that from a battery producer furnace. But I should say that the proper supervision of a plant such as that contemplated is better assured in several respects than that of a long double line of bench furnaces each one of which must be inspected in part from the charging stage and in part from the cellar of the house. As to the greater cost of labor and handling materials for the battery producer plant, he is probably correct. He admits: (1) That the combustion can be regulated more accurately with battery producer firing, "giving a gain say of 5 per cent." (2) It might be applied to a retort house without a stage floor. (3) It might be applied where the retort house stands on a bad foundation that will not bear the load of full depth benches. (4) It might be applied where the charging stage is above high water mark but where the basement floor is subject to periodic inundation. (5) It might be applied where freight charges to isolated points make the first cost of bench furnaces very high. To this I would add, in firing benches with gas distributed to them under pressure from a central plant, the combustion is not necessarily dependent on natural draft and thus a very important saving may be made in chimney losses by complete recuperation. An ordinary recuperative bench, with theoretical amount of air, and products passing into the chimney at 1,000° F., is wasting ¼ of the fuel. Finally, the operation of a central plant of producers makes possible the utilization of inferior gas coals in the retorts; and since I am inclined to agree with Mr. Bredel that battery firing offers little net advantage over ordinary practice when all the conditions are "normal," with standard gas coal, etc., it seems to me that it is in the possibility of using comparatively valueless fuel that the chief scope of battery firing lies. The best available grade of gas coal is retrograding year by year. There are many other coals whose gas yield would be entirely satisfactory and whose sulphur could be taken care of at no greatly added expense, but whose coke simply cannot be used in ordinary bench furnaces. We will some day be compelled to make our gas of this kind of coal. This ability to use a variety of coals in the retorts is of more importance than the mere capacity to consume steam, coal or breeze which the battery producer possesses and the bench furnace does not. We may not unreasonably expect to see better producers put on the market than any we have now. Considering the great simplicity of the producer principle it is surprising that most of the producers we know now are a failure. I do not see why producer gas from bituminous coal should not be made in the gas works for its own needs. Such a process as the Mond, with its by-product recovery, is surely in better hands there than anywhere else.

The President—Is there any further discussion on Mr. Bredel's paper? If not, I will ask Mr. Bredel to close.

Mr. Egner—I would like to say a word. I suppose the members of the Association think I have something to say about every paper; but have only a few remarks which I wish to make about this one. I would like to ask Mr. Bredel why he uses the expression "vertical eights," which I consider misleading. I have objected to the use of this descriptive term of horizontal retorts for some time for that reason. At the meeting of the American Gas Association at New York some years ago, that term was used for the first time to describe 8 horizontal retorts which are set in a bench in pairs directly over each other, and were called "vertical eights." I think that expression ought to be defined and corrected, so that it is understood that by "vertical eights" it is not intended to mean retorts which are *vertical*, or standing on end; but horizontal retorts grouped in pairs as just stated, each pair being located directly over the pair under it. Here in another place of Mr. Bredel's paper it is stated that "the gas entering the bench can be adjusted to a nicety and the heat regulated very easily, *provided intelligent men handle it.*" *If intelligent men handle it* we have all this with an ordinary bench. In another place Mr. Bredel says: "Most coal gas men to-day do not care what kind of a recuperator they get, and what its heating surface and heating ratio." I object to this loose generalization of what coal gas men know or care. I believe most of them *do* know and care too; and I would like Mr. Bredel to explain himself a little more fully concerning what appears to be on his part a charge of ignorance or negligence of coal gas men, concerning which I either misunderstand his meaning or else he is mistaken, and such a sweeping charge against the professional knowledge or integrity of the class of men named should not be passed over so lightly and without protest. "To overcome the continuous change in the bench fire by its one generator I have advocated a bench with twin generators." This is another quotation from Mr. Bredel's paper. But proper attention of the requirements of a single generator will do the work very well indeed; and if suitable attention is not given, or cannot be had, then, employing twin generators, it seems to me, only increases the trouble by two to one. Now about the producers. Mr. Bredel says: "In England and Scotland battery producers have been largely introduced." I may be mistaken, but I think they were also used on the continent; at Munich and Dessau, for instance, reference to which will be found in "King's Treatise on Coal Gas," but I cannot quote from volume and page at this time. Mr. Bredel further says: "Of course producers can be made to produce gas from soft coal, but in that case it becomes imperative to wash the gas." In one sense we use "battery producers" in the by-product coke oven systems, and they appear to not only be working well, but to produce some revenue, the "washing" resulting in the recovery of considerable ammonia. Returning to Mr. Bredel's recommendation that instead of using the designation of "isolated generators" the term battery producers should be employed; it must be borne in mind that what Mr. Bredel and in Germany generally is designated as "a battery of ovens" or "retorts" we in America call "a bench of retorts." In England, that which we designate as "a bench" they call "a setting," and the Germans call it "an oven," "a stack of 10 benches of sixes," or "a stack of 6 benches of nines," would in England be a bench of 10 settings of sixes, or a bench of 6 settings of nines; while in Germany it would be a "battery." So that if we adopt Mr. Bredel's suggestion as to the changing the name of the isolated generators to battery producers, we would also have to revise our other designations to some extent. On the whole Mr. Bredel's suggestion is, however, I think, a good one.

The President—If there is no further discussion I will ask Mr. Bredel to close.

Mr. Bredel—The expression "vertical 8's" was adopted by I do not know whom; I found the expression in use, so adopted it. I did not say vertical retorts; but what I said was vertical 8's. There are 2 rows of 4 retorts each placed in a vertical line, or one above the other, which explains the use of the word "vertical." I used this expression to designate this special kind of 8's from the other kind of 8's which are like benches of 9's with the lower middle retort left out. The word "battery" refers to a plurality of benches, or ovens, or whatever you might call them. If you should see fit to call a bench a furnace then it refers to a battery of furnaces. As regards to the statement that "most coal gas men do not care what kind of a recuperator is used," I must say that I find this generally to be the case, excepting when their attention is called to it. And as regard to Dr. Harrop's paper, I think what he says there about the use of a very poor grade of coal is very good; but a generator under a bench can also be made to burn a very poor grade of coal is very good; but a generator under a bench can also be made to burn a very low grade of fuel, and I have never had any trouble to design it, providing there is enough space. If there is not space enough, naturally you cannot do it.

The President—The thanks of the Association are extended to you, Mr. Bredel, for your paper. I will now call for the

Report of the Committee on President's Address.

We commend the address of the President to members of the Association, and earnestly request that it be read by all not present at the opening session, and re-read by those who listened to its reading by the President.

We suggest for your careful consideration the statement of your President as to the determining factors for variations in gas sales, which seems to have been worked out after a careful study of the subject.

This Association is greatly indebted to the gas journals of the country, as stated in the address, and your committee agrees with the sentiments as expressed, and hopes that the gas fraternity at large will give to the gas journals such assistance in the future as will assist in making them the equal of any similar publications in the world.

Although the organization of other Associations but recently are evidences of the importance and growth of the industry, still your com-

mittee feels that all kindred secieties should at present be subordinated to the American Gas Institute.

Being the last Presidential address to be delivered before this Associatlon, it is just to say that the Association can be proud of the document, as it will appear in history, and in conclusion your committee feels that it can do no better than to quote the words so well chosen by the President:

"In the march of progress, I cherish the thought and hope that those who have so bravely and loyally upheld the banner of the Western in the years that have gone, will enlist under the new flag of the American Gas Institute with the same loyalty and fortitude that has brought undying glory and fame to the Western Gas Associatton."

EDWARD G. PRATT,
FRED. R. PERSONS,
W. E. STEINWEDELL, } Committee.

The Vice-President—Gentlemen of the Association, you have heard the report of the Committee on President's Address. What is your pleasure? (On motion of Col. Pratt the report was adopted)

The President—As a special order of business, I will now call for the motion which was introduced last evening by Mr. Gimper, to reconsider the vote which was taken in the morning, ratifying and confirming the report of the Directors recommending the appointment of a committee of organization to meet with like committees of the American Gas Light Association and the Ohio Gas Light Association, in the matter of the merger and the formation of the American Gas Institute. Mr. Gimper, you may renew the motion, please, and have it seconded.

Mr. Gimper—Mr. President, before making the motion I wish to state my position in the matter.

The President—You will have to make the motion first, before the debate.

Mr. Gimper—My motion is that that part of the report of the Board of Directors referring to the union of this Association with like associations be reconsidered and acted upon separately from the report.

The President—Is there a second? (The motion was seconded) The motion is open for discussion, Mr. Gimper.

Mr. Gimper—My position on this matter is this: The Board of Directors and myself are going to the same end, only they are going one way and I wish to goanother way to reach the same result and conclusion. My motion yesterday was not made with the intention of casting any reflection upon the Board of Directors or upon their action. I feel confident that they have discharged their duties conscientiously. Most of us, nay, I may say all of us, have come here expecting to hear the death sentence of the Western Gas Association pronounced. No, I will modify that by saying that the death sentence of its name only would be pronounced, and the execution be delegated to some committee. A death sentence is always a solemn thing and should be given in solemn form, and not be tacked on at the tail end of a report and swallowed as a whole, hook, line and sinker, as was the case yesterday. There is another side to this question. Some have come here opposed to the death sentence of this Association, and when the act is finally cousummated, which I believe it will be, if we leave it in the present form those who will be dissatisfied with the act might say they have not understood that the closing paragraph of the report of the Directors was the dying act of the Association, cut and dried by them, and they had no say in the matter. I would not like to see the closing act of this Association be such that a remark of this kind had a shadow of ground. Therefore I made the resolution.

The President—Is there any further discussion? Will the gentlemen now vote for a reconsineration of that part of the report of the Board of Directors referring to the merger? Are you ready for the question?

Mr. McDonald—Before that motion is put, it seems to me that a word ought to be said. I most sincerely personally trust that this motion to reconsider will not prevail. No one in this room can possibly accuse me of being in any way unfriendly to the Western Gas Association, but I am thoroughly convinced that the coming Institute is a step forward—that is, in progress. I am also convinced, Mr. President, that it would be a great mistake now for this Association to reconsider. It would immediately create what has never occurred, I believe, in the Western Association, a difference of possibly some serious character. There are, I have no doubt, very many members of this Association committed almost irrevocably to this amalgamation, and I feel that it would be far better now, whatever might have been said before, to go on and not take a step backward. I could not hear what Mr. Gimper said, and I am sorry that I did not. I have, however, a suggestion I desire to make. If the members of the Western Gas Association desire to continue in some form an association which will be of a somewhat local character, they can easily organize such an association and go on, being, of course, contributory to the Institute. I don't desire to say any more, Mr. President, but I most sincerely hope that the members of this Association will not this morning vote to reconsider.

The President—Is there any further discussion? Are you ready for the question? (Cries of "Question.") The question is on the reconsideration of that part of the Directors' report referring to the merger. Those that are in favor of a reconsideration will manifest the same by saying aye,those that are opposed will manifest the same by saying no; the motion is lost. (Applause.) I will now appoint as the Committee of Organization, as recommended by the report of the Directors, which has your approval, the officers of the Association—Mr. Mitchell, Mr. Baehr, Mr. Dunbar, Mr. Donald McDonald, and your President, myself. Mr. Donald McDonald and myself have represented the Western Gas Association in all of the preliminary work of organization, and it has been suggested that the members who are most familiar with the work of organization be retained on this merger committee. The committee will consist of Mr. Mitchell, Mr. Baehr, Mr. Dunbar, Mr. Donald McDonald and Mr. Paul Doty. The next order of business is the illustrated lecture by Mr. Lansingh. I present to you, gentlemen, Mr. Van Rensselaer Lansingh, of New York, a member of the Society of Illuminating Engineers, who will address you this morning on

THE ENGINEERING OF ILLUMINATION.

I would like to say, before I start, that this subject of illumination is such a broad and complex one that in this paper I will only endeavor to touch on a few points and to give some of the fundamental data, such as photometric curves, which are necessary before any calculations can be made in designing illumination.

Until the last few years, and even to-day, in some cases, the question of illumination has not been recognized as being of any special interest or concern of the gas engineer. His buisness has been to supply gas to the consumer, leaving it to the latter to obtain whatever benefit he could thereby. In other words, the gas man, like the electric man, has sold cubic feet of gas or in the case of electric man, kilowatts and not illumination.

Owing to the stimulating effect of electric competition, this attitude of the practical gas man has been gradually altered, until to-day most gas companies endeavor to help the customer obtain the maximum light from the gas he uses, generally by encouraging the use of some from of mantle burner.

The next step is naturally to assist the customer to obtain, not only the maximum light from the gas he uses, but the best illumination; that is assist him in getting the illumination he desires, which means the ability to see things comfortably and economically. While the customer actually pays the gas company for cubic feet of gas used, it is simply a means to an end, that end being the ability to see well, and the present spirit of co-operation between producer and user, now so manifest in the gas world, is bound to produce in the long run the best results for the gas company in dollars and cents.

Illumination, or the effect obtained by light, is not purely an engineering problem requiring only technical knowledge, but it also embraces thorough practical knowledge and experience, as well as a sense of the artistic. It does, however, present so many problems requiring special study, engineering knowledge and technical skill, that the illuminating engineer is, to-day, at least in the electrical field, of recognized standing. The object of this paper, therefore, is to point out some of the fundamental principles necessary to such a knowledge and the application of the same to everyday pro blems of lighting.

The writer has undertaken to state at the outset some of the primary principles of light and its measurement, which to those well familiar with the subject may be passed over. He has found, however, among practical gas men, men familiar with light sources and with the term candle power as ordinarily used, such a lack of knowledge of the general subject, that he deems it wise to present here, in more or less detail, some of the underlying principles necessary to the correct understanding of good illumination.

Laws of Light.—Light is ordinarily measured in terms of candle power, the unit being the light given on the horizontal from a standard candle burning at a given rate. It is customary to measure most forms of illuminants by the light given on the horizontal, as they generally give their maximum light in that direction, but in order to correctly judge of the efficiency of a source of light (by efficiency is meant the ratio of the total flux of light to the energy consumed), we must take into account not only the maximum light, but also the light given in other directions; that is, the mean spherical candle power. In other words, if the source of light in question gives the same total amount of light, but equally in all directions, we would term this the mean

spherical candle power. As long as sources of light were of the same shape and size, it was sufficient to compare their mean horizontal candle power, but with sources differing as they do to-day in both respects, we must judge of their relative efficiencies by the total amount of light and not by the amount given in any one direction. This sounds like a truism, but from some of the advertising of some of the manufacturers, in regard to candle power, where light in given directions is added together to give the rated candle power, it would appear necessary to call attention to such errors.

Such measurements of light are made on a photometer, which is an instrument simple in theory but involving many factors in actual practice. The length of this paper precludes a discussion of photometry, but the fundamental principles of the same will be briefly described.

All photometers are based on the law of inverse squares which states that light varies inversely with the square of the distance. Fig. 1 illustrates this graphically. It is evident from an inspection of this that a surface *C*, twice the distance of *B* from the source of light, will have only one-fourth the light falling on each point and that *D* will only have one-ninth, since the area illuminated in both cases by the same rays are, respectively, 4 and 9 times that of *B*.

Fig. 2 shows a Bunsen photometer diagrammatically. Briefly, it

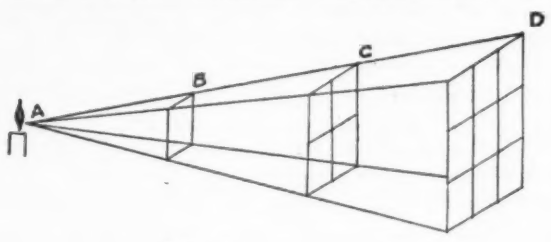

FIG. 1
Illustrating the Law of Inverse Squares.

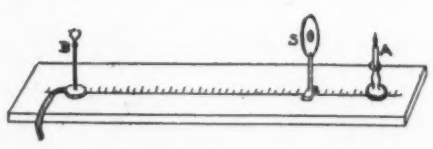

FIG. 2
Showing Principle of Photometer.

consists of a standard source of light *A*, the source of light to be measured *B*, and a screen *S*, which is composed of 3 layers of paper, the center one being thin, like tissue paper, while the two outer ones are heavier, having a central opening, either round or star shaped. When seen by reflected light the centre will appear darker than the outside, since part of the light is transmitted and therefore less reflected. If viewed by transmitted light, *i. e.*, light from the opposite side, the center will appear lighter than the outside, which does not allow the light to pass through. In operation the screen is moved back and forth until the center spot is equally bright with the outside portion. By means of 2 mirrors placed at an angle, both sides of the screen can be seen at the same time, and when they are equally bright the 2 lights are inversely proportional to the square of the distances from the screen. Thus, if the distance from *A* to *S* is 1 foot and from *B* to *S* 4 feet, light *B* will be 16 times the strength of light *A*.

This would measure only the horizontal candle power. To get the candle power at other angles, the light *B* could be tipped, but in the case of gas measurements this is undesirable, as generally lights are made to burn in a vertical position, so that in actual practice a series of mirrors are used, which reflect the light at different angles into the photometer without necessitating the movement of the source of light. Fig. 3 shows a cut of the photometer used for testing gas lights by the electrical testing laboratories.

This device consists primarily of 3 mirrors, each 22 by 31 inches, by means of which the light from the source to be measured may be thrown upon the photometer. It is always incident upon the photometer at normal, irrespective of angle at which it emanates from the source. The mirrors are supported by a stout framework of iron, which can be rotated upon a horizontal axis, the prolongation of which passes through the source of light and the photometer. The mirrors are placed in position so as to receive the light at the desired angle in the vertical plane and are clamped in such position. They are rotated easily, being balanced by the weight *E*. In the illustration a ceiling fan electric motor is shown for the purpose of rotating an electric lamp. It can be

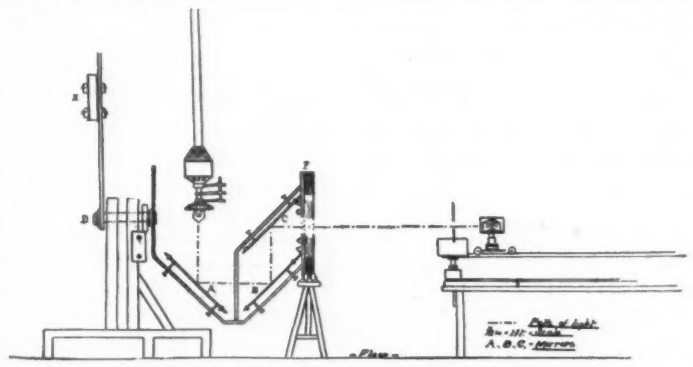

Fig. 3.—Mirror Reflector Photometer—Scale about 1 to 64.

replaced by a gas fixture. With this device sources of light not exceeding 18 inches in diameter can be measured successfully.

It should be borne in mind that a photometer measures not only the intensity of light but also the quantity (by intensity is meant the candle power per square inch of illuminating surface), and that in comparing different sources os light it is necessary to take both these factors into account. For example, the intensity of the filament of a 16-candle power, 3.1-watt incandescent electric lamp is approximately 500-candle power per square inch, which is 16 times as great as that of a mantle burner giving 30 candle power per square inch, although on account of the area of the mantle the quantity of light given by the latter is much greater. Both of these factors must be borne in mind when considering the effect on the eye of any source of light.

Illumination.—The difference between light and illumination should be carefully noted. Light is a cause; illumination an effect. An object on which light falls becomes illuminated. Illumination, therefore, is the result produced by light. An object is well illuminated when it can be easily seen without fatigue or strain on the eyes. Good illumination, therefore, requires several things, among which may be mentioned:

1. Sufficient light to enable one to see clearly and distinctly.
2. Avoidance of too much light, which produces a blinding and fatiguing effect on the eye.
3. Avoidance of having a bright light in the field of vision, which cuts down the ability to see clearly things which are less brilliantly illuminated.
4. Avoidance of streaks or striations, which, however, are more noticeable with electric than with gas lights.
5. A steady light—*i. e.*, avoidance of a flickering light, like an open flame burner with insufficient draft, which quickly tires even the strongest of eyes.
6. Avoidance of regular reflection, which is commonly known as glare, due to the light striking an object at such an angle that a large part of the light is reflected directly into the eyes.
7. Avoidance of two sharp contrasts, such as, for example, a brilliantly lighted desk with the rest of the room in darkness.

From the foregoing it will he seen that, in considering any form of illumination, it is absolutely necessary to take into consideration the effect on the eye. Nature has given us in the eye a wonderful and delicate camera, which with proper care can be used indefinitely, but which, with the introduction of lights of high intrinsic brilliancy, we have shamefully misused. Witness to-day the percentage of people wearing glasses in this country compared with 25 years ago, and especially note the report of our oculists on the rapid increase of glasses among children, and it will be self-evident that, unless proper care is taken of the eyes, we shall all soon be compelled to resort to the oculists to overcome the defects due almost wholly to bad lighting. One oculist in Chicago states that the lighting of the magnificent Auditorium, with its rows of bare incandescent lamps, has brought him in thousands of dollars' worth of business. With these facts in mind, do we not owe, not only to ourselves but to the public in general, to do what we can to overcome such conditions?

We thus see that in dealing with modern sources of light it is necessary to take into account the effect of the same on the eye, and in every case reduce the intrinsic brilliancy as far as possible. With electric incandescent lamps it is possible sometimes to conceal them entirely from view, thus getting indirect illumination, which is generally satisfactory except from the standpoint of economy. With gas such treatment is usually out of the question, although not always so, and we should, therefore, place our lights high enough to be out of the field of vision wherever possible, and to use diffusing globes, which not only cut down the intrinsic brilliancy, and therefore make it possible to see

with much more comfort, but actually enable us to see more clearly, owing to the eye being enabled to work with a wider aperture. It is, therefore, necessary to study the effects, not of the lights alone, but with the glassware which it is desired to use. The absorption or loss of light due to the surrounding globes, as well as their distribution, must be considered. Such figures will be given later in the paper.

PHOTOMETRIC CURVES.[1]

Upright Mantle Burners.—We have already seen that sources of light do not give the same candle power in all directions. Thus, in the case of a bare mantle burner, the photometric curve of which is shown in Fig. 4, we have 83-candle power on the horizontal, but directly underneath practically none, owing the shadow cast by the burner. If we measure the candle power of the light as seen from different angles and represent the intensity at these different angles by the distance from a fixed point, we have what is known as a photometric curve. By such a curve we can at once obtain the intensity or candle power at any given angle, by simply measuring the distance from the center to where the curve is cut by the line. Thus in Fig. 4 we have 39-candle power at 60° and 77-candle power at 15° below the horizontal. It should also be noticed that 55 per cent. of the light goes above the horizontal and only 45 per cent. below, which means, as lights are practically placed above the level of the eyes, that, unless some means be taken to throw this downward, one-half of the light is wasted, except except for the indirect reflection of ceiling and high side walls. Fig. 5 shows the curve of the same burner equipped with a small fluted porcelain shade.

While such a shade does not hide the bare mantle and therefore does not aid in the diffusion, it does give an increase of light at all angles below the horizontal, and as such is to be preferred to the bare mantle.

Fig. 6 shows the curve of the common 6 air-hole opal Q globe, burning 5.1 cubic feet of gas per hour at 1.5 inches pressure. Inasmuch as its intensity is less than the bare mantle, it is to be preferred to the small flat fluted porcelain shade, although its efficiency is much less. In all comparisons we must bear in mind both diffusion and distribution, and, inasmuch as it is seldom that we get both factors in one globe, we must select that which is most necessary for the case in hand.

Fig. 7 shows the curve of the ordinary ground glass, tulip shaped globe. This globe simply diffuses and softens the light without materially altering the distribution. Its absorption is over 25 per cent.

Fig. 8 shows the curve of a fancy tulip globe, with dark mottling and stripes. Its absorption is over 50 per cent. Such globes give very artistic results, good diffusion, and, where economy is no object and a sufficient number can be used to get the required illumination, they are to be highly recommended.

Fig. 9 shows the curve of what is known as a Class A holophane globe, shown in Fig. 9A, designed to throw the light directly downward, such as for use over dining room and library tables. It gives a remarkable amount of light downward, but, of course, at the expense of the light at other angles. Its absorption is about 18 per cent. The diffusion obtained by such globes is about equal to that of opal, without, however, the large absorption, inasmuch as the globes are made of perfectly clear glass and depend upon their accurate design for their diffusing and redirecting qualities. Such globes, owing to their prismatic faces, are apt to collect the dust, and should therefore be kept clean. The dust, however, affects their appearance more than their efficiency, the additional absorption of a dusty globe being about 13 per cent. They should never be used in places where the air is greasy, such as over stoves, as the grease is apt to settle on the prisms, and is extremely difficult to remove. When such globes, however, are used intelligently, they form an important adjunct to the illuminating engineer's work, as they combine both qualities of diffusion and redirecting powers with small absorption.

Fig. 10 shows the curve of what is known as a Class B holophane globe, shown in Fig. 10A, designed to give a general distribution rather than special. Its absorption is about 12 per cent.

Fig. 11 shows the rather remarkable curve of what is known as a Class C holophane globe, designed to throw the light sideways just below the horizontal, in order to cover a wide area. The tests show an absorption of only 6 per cent., which is probably too low.

It will be noted by a comparison with the curve of the bare mantle shown by the dotted line, that there is actually an increase on the horizontal, where the bare light is a maximum, and a considerable increase to as for as 30° below. As these angles are the critical ones in street lighting, the writer ventures the opinion that, if such a globe were properly protected from the rain and dust by inclosing it in the ordinary street post lantern, it would increase the lighting of our streets in two ways. First, by an actual increase of the light falling on the street, and second, because of its diffusing qualities it would enable a pedestrian to see more clearly, owing to the fact that the eye, not being blinded by an intense light, could work with a larger aperture, and therefore see more clearly and distinctly.

Fig. 12 shows the curve of an opal dome and opal bobesche. Such a combination is good for reading when the light is directly above the work. A bobesche should always be used with a dome shade whenever there is a possibility of the eye being able to see the mantle. As a matter of fact, bobesches should be made about half an inch deeper, as at present most of them do not come high enough to cut out all view of the bare mantle.

Fig. 13 shows the curve of a similar green dome shade and opal bobesche. This makes a splendid reading light if directly above the work, but concentrates it too much if used on a low portable, with the reader sitting alongside the table. A green dome with green bobesche is practically out of the question, owing to the large absorption of the cup. Such a combination depends almost entirely on the reflection from the white lining of the green dome and is very inefficient.

Fig. 14 shows the curve of a green dome and Class A Holophane bobesche.

This bobesche, being higher, cuts off all view of the mantle and gives a strong light at all angles. A comparison of this with Figs. 12 and 13 is intructive, and shows how easily illumination may be improved by slight changes.

Open Flat Gas Flame Burner Curves.—In considering the distribution of light from a mantle burner we have assumed that it was symmetrical on the horizontal, *i. e.*, if we looked at the light from one side or the opposite side it was the same. This is so nearly true that it can be safely assumed.

Fig. 15 shows the distribution curve in a horizontal plane of a flat flame burner showing that when viewed at right angles to the plane of the flame, the candle power is slightly greater than when viewed end on, due to the fact that the hot particles of carbon slightly shade the light from other parts of the flame. It is not as great, however, as one would suppose and shows that, generally speaking, it is immaterial at what angle the tip of the burner is placed.

Fig. 16 shows the vertical distribution of an unshaded open gas burner taken at right angles to the plane of the flame. It will be noticed that the curve of light is remarkably uniform with the exception of directly underneath where a small shadow is made by the pillar and the tip. Also, as in the case of the mantle burner, practically one-half of the light is above and one-half below the horizontal.

The President—If I may interrupt you, Mr. Lansingh, what would be the candle power of such a gas? If some one were to ask you the candle power of that gas, what would you say?

Mr. Lansingh—If you can answer me what the candle power of New York gas is, I will tell you. These tests were all made at the electrical testing laboratories, so as to have an absolutely unbiased source, and if anybody can answer me the candle power of the New York gas, that is the answer to the question.

Mr. Gardiner—I think the candle power on the horizontal is 20, or perhaps a fraction plus, on the last diagram.

Mr. Lansingh—It was 20-candle power, but I have not with me, at least in this paper, the number of cubic feet of gas which that tip was consuming. That data, however, can be easily obtained.

Mr. Lansingh (continuing lecture)—Fig. 17 shows a distribution curve of an etched glass globe, representing perhaps a great majority of open flame globes. It should be noticed that there is a comparatively small absorption, vis., about 14 per cent., but that a large amount of the light is thrown upward, the globe acting somewhat as a reflector, there being a diminition of 30 per cent. below the horizontal.

The real efficiency of a globe should not be measured, generally speaking, by the amount of light it gives forth, but rather by the amount of light which it throws below the horizontal, or in some particular direction where the light is wanted. Thus in the case of the globe shown in Fig. 17, although its absorption is comparatively small, the loss of light below the horizontal is rather large, and as this is the light which is generally used, we see that in our efforts to obtain an artistic effect and at the same time shield the eyes, we do so at a considerable loss.

1. All of the tests here given, with two exceptions, were made by the Electrical Testing Laboratories, so as to have comparable results from an unbiased source. The different curves are not comparable as to absolute values, unless so specifically stated, but only as to their relative distribution, inasmuch as the tests were made on different burners with different lengths and styles of chimneys and therefore under different conditions.

It should also be noted that in the case of open flame burners the necessity for diffusion is not nearly as great as with mantle burners, as both the intensity and quantity of light are low.

Fig. 18 shows the curve of a beaded and ribbed globe. The absorption of this globe is low, as it is made of perfectly clear glass, but it also has the same tendency as all such globes, to act slightly as a reflector and throws much more light above than below the horizontal.

Fig. 19 shows a Class A holophane globe designed to diffuse the light and at the same time throw a strong light downward. Its absorption is about the same as the other open gas globes, but its distribution curve is entirely different.

Inverted Burner.—In studying the distribution of light from an inverted burner, the first thing one notices is the marked difference between it and the upright burner. Thus, in the case of the bare upright mantle burner we have 55 per cent. of the light above the horizontal and 45 per cent. below, while in the case of the inverted burner we have only 33 per cent. above horizontal and 67 per cent. below. From this we would naturally draw two conclusions:

1 As lights will, in general, be placed on present chandeliers, they will be lower, and, therefore, the necessity for a diffusing globe will be greater, especially as the temperature of the mantle is higher and of greater intrinsic brilliancy.

2. The necessity for redirecting the rays below the horizontal will not be as great as formerly.

A corollary which naturally follows, is that a greater variety of globes or shades will be permissible, inasmuch as the tendency of any open form of shade will be to throw the light downward, whereas with upright burners we have the exact opposite.

Fig. 20 shows the curve of an inverted burner with a small, clear chimney, but no outer globe. This gives a mean spherical candle power of 54, with a consumption of 3 cubic feet of gas per hour, or 18 mean spherical candle power per cubic foot of gas. Comparing this with the standard upright mantle burner, not of the air hole pattern, we find that the efficiency of the two are practically the same, as the test shown in Fig. 4 give a mean spherical candle power of 63, with a consumption of 3.7 cubic feet of gas per hour, or 17 mean spherical candle power per cubic foot of gas.

Fig. 21 shows the curve of a dense opal globe on an inverted burner consuming 3.85 cubic feet of gas per hour. The mean spherical candle power of this combination was 55.7, or 14.5-candle power per cubic foot of gas. This should be compared with Fig. 6, which is an upright air-hole burner with an opal chimney, burning 5.1 cubic feet of gas per hour; as the mean spherical candle power of this is 45.8. we have only 9-candle power per cubic foot of gas, so that the upright air-hole style is extremely inefficient when compared with either the inverted or standard upright type of burner.

Fig. 22 shows the photometrie curve of the same burner used in Fig. 20, equipped with a pagoda reflector. It will be noted that this gives and extremely downward light but at the same time throws a good light to the sides. There is an increase in illumination at all angles below 30° from the horizontal.

Fig. 23 shows the same burner as is used in Fig. 20, equipped with a holophane diffusing globe, showing that it is possible to obtain good diffusion with an increase of light at all angles below the horizontal.

Fig. 24 shows the same burner as shown in Fig. 20, equipped with a flat porcelain reflector. It will be noted that in Figs. 24 and 25 the curves are not carried above the horizontal. Both of these tests are due to the courtesy of the manufacturers, all the other tests having been made by the electrical testing laboratories.

Fig. 25 shows the curve of the same burner with an 8-inch deep cone reflector. This should be compared with Fig. 22. It should be noted that the two are not drawn to the same scale.

Gas Arcs.—The length of this paper precludes much of a discussion as to the relative merits of cluster gas arcs as compared with individual mantle burners, either upright or inverted.

It should be noticed, however, that a 4-mantle gas arc does not give as high an efficiency, with respect to its total flux of light, as 4 individual burners. Thus, in the case of the standard upright burner consuming 3.7 cubic feet of gas per hour, shown in Fig. 4, we have 63 mean spherical candle power, or 17-candle power per cubic foot of gas. The mean spherical candle power of the most efficient type of 4-mantle gas arc, burning 21 cubic feet of gas per hour, is about 250, or 12-candle power per cubic foot. This means a reduction of nearly 30 per cent.

The reason for this will be seen at once when we note that the mantles largely shade each other, thereby lowering the total efficiency, although each mantle gives more light than the individual burner.

Outside of the question of efficiency, it can also be said that, in general, better distribution of light can be obtained from small units properly placed and with the right shades than with large ones. For the above reasons it does not seem wise to advocate the gas arc, except in special cases and under certain conditions.

As far as the writer knows, little if any reliable data has been published on gas arcs with respect to their distribution, their relative efficiency as compared with individual burners, etc., consequently two of the best known ypes were selected for test.

Fig. 26 shows the distribution in a horizontal plane of gas arc No. 1 (the Welsbach). It should be noticed that the distribution is unsymmetrical, there being a difference of over 35 per cent. between the maximum and minimum. In one position only two mantles are visible, while by shifting the point of view 30° three of the mantles are entirely visible and the fourth partially so.

Mr. Mitchell—What amount of gas was used in that arc light?

Mr. Lansingh—That test there shows a consumption, I think, of about 21 cubic feet of gas per hour. Here we have a test of the same arc on which I have reliable data. (Continuing the lecture.)

We should, therefore, note that in installing such arcs they should be placed so as to secure their maximum candle power in the proper direction, a point of considerable practical use, but seldom taken advantage of, as it is thus possible to materially increase the illumination in given directions without any additional cost.

Fig. 27 shows two photometric curves, in a vertical plane, of the same

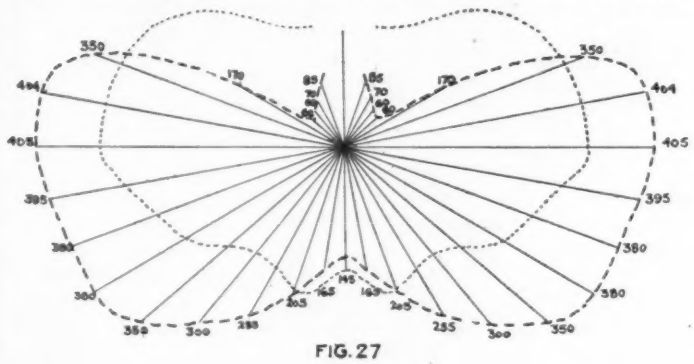

FIG. 27

Curves of Gas Arc No. 1

---Clear Globe, with Reflector.

.....Alabaster Globe, No Reflector.

lamp, the dash line representing it equipped with a clear globe and flat porcelain reflector, while the dotted line represents it equipped with alabaster globe without reflector. It will be noted that, except directly underneath, there is a material increase in the useful light due to the use of the clear globe and reflector; but, on account of the diffusion obtained by the alabastor globe, it is, generally speaking, better to sacrifice the increase of light, whenever the mantles are apt to fall directly in the line of vision.

Tests were made in two vertical planes, the first, normal to the common vertical plane of two adjacent mantles. In this case only two mantles were visible. The second vertical plane investigated was 45° removed from the first. In this plane three mantles were visible. The indicated mean spherical candle power and the indicated mean lower hemispherical candle power values are computed from the intensities determined by measurements in a certain vertical plane. As the distribution of light in the horizontal plane about the lamp is non-uniform, neither of the values given represents the true mean spherical candle power, which will lie somewhere between them. This can be verified at once by reference to the horizontal distribution curve. The results of the tests on this arc are as follows:

	Clear Globe with Porcelain Reflector.		Alabaster Globe, Second Plane.
	First Plane.	Second Plane.	
Pressure	1.5	1.5	1.5
Consumption	21.0	21.0	22.5
Indicated mean spherical candle power	230.0	267.0	245.0
Indicated mean lower hemispherical candle power	281.0	345.0	240.0
Mean spherical candle power per cubic foot	11 0	12.7	10.9
Mean lower hemispherical candle power per cubic foot	13.4	16.4	10.7

Mr. T. D. Miller—I would like to ask what kind of mantle you used, what length of mantle, whether it was center support or their were side supports to those mantles under this test?

Mr. Lansingh—I was not present when these tests were made. I

with much more comfort, but actually enable us to see more clearly, owing to the eye being enabled to work with a wider aperture. It is, therefore, necessary to study the effects, not of the lights alone, but with the glassware which it is desired to use. The absorption or loss of light due to the surrounding globes, as well as their distribution, must be considered. Such figures will be given later in the paper.

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It will be noted by a comparison with the curve of the bare mantle shown by the dotted line, that there is actually an increase on the horizontal, where the bare light is a maximum, and a considerable increase to as for as 30° below. As these angles are the critical ones in street lighting, the writer ventures the opinion that, if such a globe were properly protected from the rain and dust by inclosing it in the ordinary street post lantern, it would increase the lighting of our streets in two ways. First, by an actual increase of the light falling on the street, and second, because of its diffusing qualities it would enable a pedestrian to see more clearly, owing to the fact that the eye, not being blinded by an intense light, could work with a larger aperture, and therefore see more clearly and distinctly.

Fig. 12 shows the curve of an opal dome and opal bobesche. Such a combination is good for reading when the light is directly above the work. A bobesche should always be used with a dome shade whenever there is a possibility of the eye being able to see the mantle. As a matter of fact, bobesches should be made about half an inch deeper, as at present most of them do not come high enough to cut out all view of the bare mantle.

Fig. 13 shows the curve of a similar green dome shade and opal bobesche. This makes a splendid reading light if directly above the work, but concentrates it too much if used on a low portable, with the reader sitting alongside the table. A green dome with green bobesche is practically out of the question, owing to the large absorption of the cup. Such a combination depends almost entirely on the reflection from the white lining of the green dome and is very inefficient.

Fig. 14 shows the curve of a green dome and Class A Holophane bobesche.

This bobesche, being higher, cuts off all view of the mantle and gives a strong light at all angles. A comparison of this with Figs. 12 and 13 is intructive, and shows how easily illumination may be improved by slight changes.

Open Flat Gas Flame Burner Curves.—In considering the distribution of light from a mantle burner we have assumed that it was symmetrical on the horizontal, *i. e.*, if we looked at the light from one side or the opposite side it was the same. This is so nearly true that it can be safely assumed.

Fig. 15 shows the distribution curve in a horizontal plane of a flat flame burner showing that when viewed at right angles to the plane of the flame, the candle power is slightly greater than when viewed end on, due to the fact that the hot particles of carbon slightly shade the light from other parts of the flame. It is not as great, however, as one would suppose and shows that, generally speaking, it is immaterial at what angle the tip of the burner is placed.

Fig. 16 shows the vertical distribution of an unshaded open gas burner taken at right angles to the plane of the flame. It will be noticed that the curve of light is remarkably uniform with the exception of directly underneath where a small shadow is made by the pillar and the tip. Also, as in the case of the mantle burner, practically one-half of the light is above and one-half below the horizontal.

The President—If I may interrupt you, Mr. Lansingh, what would be the candle power of such a gas? If some one were to ask you the candle power of that gas, what would you say?

Mr. Lansingh—If you can answer me what the candle power of New York gas is, I will tell you. These tests were all made at the electrical testing laboratories, so as to have an absolutely unbiased source, and if anybody can answer me the candle power of the New York gas, that is the answer to the question.

Mr. Gardiner—I think the candle power on the horizontal is 20, or perhaps a fraction plus, on the last diagram.

Mr. Lansingh—It was 20-candle power, but I have not with me, at least in this paper, the number of cubic feet of gas which that tip was consuming. That data, however, can be easily obtained.

Mr. Lansingh (continuing lecture)—Fig. 17 shows a distribution curve of an etched glass globe, representing perhaps a great majority of open flame globes. It should be noticed that there is a comparatively small absorption, vis., about 14 per cent., but that a large amount of the light is thrown upward, the globe acting somewhat as a reflector, there being a diminition of 30 per cent. below the horizontal.

The real efficiency of a globe should not be measured, generally speaking, by the amount of light it gives forth, but rather by the amount of light which it throws below the horizontal, or in some particular direction where the light is wanted. Thus in the case of the globe shown in Fig. 17, although its absorption is comparatively small, the loss of light below the horizontal is rather large, and as this is the light which is generally used, we see that in our efforts to obtain an artistic effect and at the same time shield the eyes, we do so at a considerable loss.

1. All of the tests here given, with two exceptions, were made by the Electrical Testing Laboratories, so as to have comparable results from an unbiased source. The different curves are not comparable as to absolute values, unless so specifically stated, but only as to their relative distribution, inasmuch as the tests were made on different burners with different lengths and styles of chimneys and therefore under different conditions.

It should also be noted that in the case of open flame burners the necessity for diffusion is not nearly as great as with mantle burners, as both the intensity and quantity of light are low.

Fig. 18 shows the curve of a beaded and ribbed globe. The absorption of this globe is low, as it is made of perfectly clear glass, but it also has the same tendency as all such globes, to act slightly as a reflector and throws much more light above than below the horizontal.

Fig. 19 shows a Class A holophane globe designed to diffuse the light and at the same time throw a strong light downward. Its absorption is about the same as the other open gas globes, but its distribution curve is entirely different.

Inverted Burner.—In studying the distribution of light from an inverted burner, the first thing one notices is the marked difference between it and the upright burner. Thus, in the case of the bare upright mantle burner we have 55 per cent. of the light above the horizontal and 45 per cent. below, while in the case of the inverted burner we have only 33 per cent. above horizontal and 67 per cent. below. From this we would naturally draw two conclusions:

1 As lights will, in general, be placed on present chandeliers, they will be lower, and, therefore, the necessity for a diffusing globe will be greater, especially as the temperature of the mantle is higher and of greater intrinsic brilliancy.

2. The necessity for redirecting the rays below the horizontal will not be as great as formerly.

A corollary which naturally follows, is that a greater variety of globes or shades will be permissible, inasmuch as the tendency of any open form of shade will be to throw the light downward, whereas with upright burners we have the exact opposite.

Fig. 20 shows the curve of an inverted burner with a small, clear chimney, but no outer globe. This gives a mean spherical candle power of 54, with a consumption of 3 cubic feet of gas per hour, or 18 mean spherical candle power per cubic foot of gas. Comparing this with the standard upright mantle burner, not of the air hole pattern, we find that the efficiency of the two are practically the same, as the test shown in Fig. 4 give a mean spherical candle power of 63, with a consumption of 3.7 cubic feet of gas per hour, or 17 mean spherical candle power per cubic foot of gas.

Fig. 21 shows the curve of a dense opal globe on an inverted burner consuming 3.85 cubic feet of gas per hour. The mean spherical candle power of this combination was 55.7, or 14.5-candle power per cubic foot of gas. This should be compared with Fig. 6, which is an upright air-hole burner with an opal chimney, burning 5.1 cubic feet of gas per hour; as the mean spherical candle power of this is 45.8. we have only 9-candle power per cubic foot of gas, so that the upright air-hole style is extremely inefficient when compared with either the inverted or standard upright type of burner.

Fig. 22 shows the photometrie curve of the same burner used in Fig. 20, equipped with a pagoda reflector. It will be noted that this gives and extremely downward light but at the same time throws a good light to the sides. There is an increase in illumination at all angles below 30° from the horizontal.

Fig. 23 shows the same burner as is used in Fig. 20, equipped with a holophane diffusing globe, showing that it is possible to obtain good diffusion with an increase of light at all angles below the horizontal.

Fig. 24 shows the same burner as shown in Fig. 20, equipped with a flat porcelain reflector. It will be noted that in Figs. 24 and 25 the curves are not carried above the horizontal. Both of these tests are due to the courtesy of the manufacturers, all the other tests having been made by the electrical testing laboratories.

Fig. 25 shows the curve of the same burner with an 8-inch deep cone reflector. This should be compared with Fig. 22. It should be noted that the two are not drawn to the same scale.

Gas Arcs.—The length of this paper precludes much of a discussion as to the relative merits of cluster gas arcs as compared with individual mantle burners, either upright or inverted.

It should be noticed, however, that a 4-mantle gas arc does not give as high an efficiency, with respect to its total flux of light, as 4 individual burners. Thus, in the case of the standard upright burner consuming 3.7 cubic feet of gas per hour, shown in Fig. 4, we have 63 mean spherical candle power, or 17-candle power per cubic foot of gas. The mean spherical candle power of the most efficient type of 4-mantle gas arc, burning 21 cubic feet of gas per hour, is about 250, or 12-candle power per cubic foot. This means a reduction of nearly 30 per cent.

The reason for this will be seen at once when we note that the mantles largely shade each other, thereby lowering the total efficiency, although each mantle gives more light than the individual burner.

Outside of the question of efficiency, it can also be said that, in general, better distribution of light can be obtained from small units properly placed and with the right shades than with large ones. For the above reasons it does not seem wise to advocate the gas arc, except in special cases and under certain conditions.

As far as the writer knows, little if any reliable data has been published on gas arcs with respect to their distribution, their relative efficiency as compared with individual burners, etc., consequently two of the best known ypes were selected for test.

Fig. 26 shows the distribution in a horizontal plane of gas arc No. 1 (the Welsbach). It should be noticed that the distribution is unsymmetrical, there being a difference of over 35 per cent. between the maximum and minimum. In one position only two mantles are visible, while by shifting the point of view 30° three of the mantles are entirely visible and the fourth partially so.

Mr. Mitchell—What amount of gas was used in that arc light?

Mr. Lansingh—That test there shows a consumption, I think, of about 21 cubic feet of gas per hour. Here we have a test of the same arc on which I have reliable data. (Continuing the lecture.)

We should, therefore, note that in installing such arcs they should be placed so as to secure their maximum candle power in the proper direction, a point of considerable practical use, but seldom taken advantage of, as it is thus possible to materially increase the illumination in given directions without any additional cost.

Fig. 27 shows two photometric curves, in a vertical plane, of the same

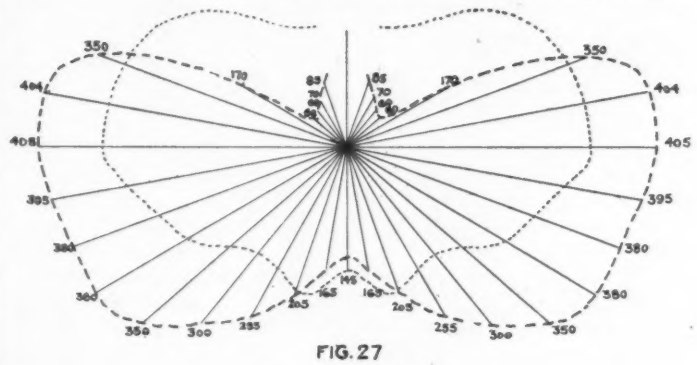


FIG. 27

Curves of Gas Arc No. 1

---Clear Globe, with Reflector.

.....Alabaster Globe, No Reflector.

lamp, the dash line representing it equipped with a clear globe and flat porcelain reflector, while the dotted line represents it equipped with alabaster globe without reflector. It will be noted that, except directly underneath, there is a material increase in the useful light due to the use of the clear globe and reflector; but, on account of the diffusion obtained by the alabastor globe, it is, generally speaking, better to sacrifice the increase of light, whenever the mantles are apt to fall directly in the line of vision.

Tests were made in two vertical planes, the first, normal to the common vertical plane of two adjacent mantles. In this case only two mantles were visible. The second vertical plane investigated was 45° removed from the first. In this plane three mantles were visible. The indicated mean spherical candle power and the indicated mean lower hemispherical candle power values are computed from the intensities determined by measurements in a certain vertical plane. As the distribution of light in the horizontal plane about the lamp is nonuniform, neither of the values given represents the true mean spherical candle power, which will lie somewhere between them. This can be verified at once by reference to the horizontal distribution curve. The results of the tests on this arc are as follows:

	Clear Globe with Porcelain Reflector.		Alabaster Globe, Second Plane.
	First Plane.	Second Plane.	
Pressure	1.5	1.5	1.5
Consumption	21.0	21.0	22.5
Indicated mean spherical candle power	230.0	267.0	245.0
Indicated mean lower hemispherical candle power	281.0	345.0	240.0
Mean spherical candle power per cubic foot	11 0	12.7	10.9
Mean lower hemispherical candle power per cubic foot	13.4	16.4	10.7

Mr. T. D. Miller—I would like to ask what kind of mantle you used, what length of mantle, whether it was center support or their were side supports to those mantles under this test?

Mr. Lansingh—I was not present when these tests were made. I

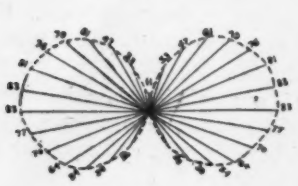


FIG. 4
Curve of Bare Incandescent Lamp
Mantle Burner

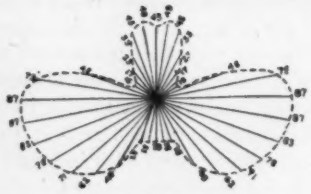


FIG. 5
Curve of Fluted Porcelain Shade over
Mantle Burner

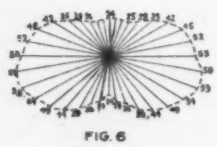


FIG. 6
Curve of Opal Q. Chimney
Mantle Burner

FIG. 7
Curve of Ground Glass Globe
Mantle Burner

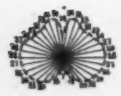


FIG. 8
Curve of Fancy Opal Globe
Mantle Burner

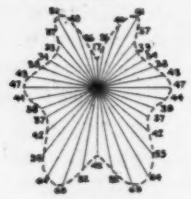


FIG. 9
urve of Holophane Class A Globe
Mantle Burner

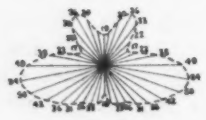


FIG. 10
Curve of Holophane Class B Globe
Mantle Burner

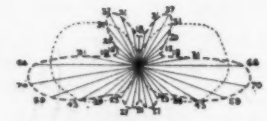


FIG. 11
---- Curve of Holophane Class C Globe
..... Curve of Mantle Burner Bare.

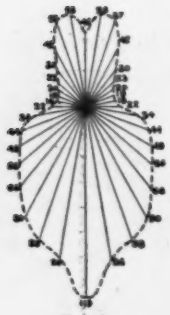


FIG. 12
Curve of Opal Dome & Opal Bobesche
Mantle Burner.

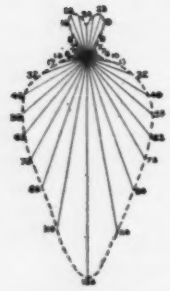


FIG. 13
Curve of Green Dome & Opal Bobesche
Mantle Burner

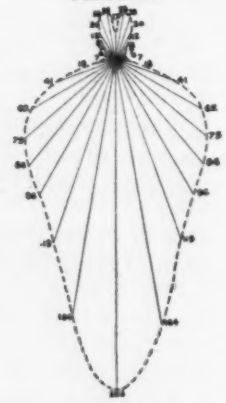


FIG. 14
Curve of Green Dome & Holophane Bobesche
Mantle Burner

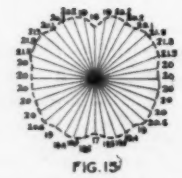


FIG. 15
Curve of Open Gas Horizontal Distribution

FIG. 16
Curve of Open Gas Vertical Distribution

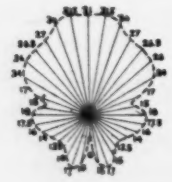


FIG. 17
Open Gas Etched Globe

FIG. 18.
Curve of Open Gas Pressed Glass Globe

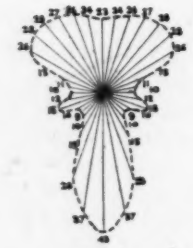


FIG. 19
Curve of Open Gas Holophane Class A Globe

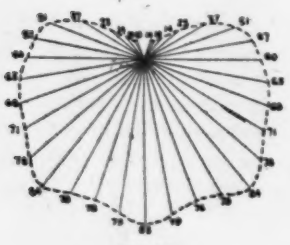


FIG. 20
Curve of Bare Inverted Burner.

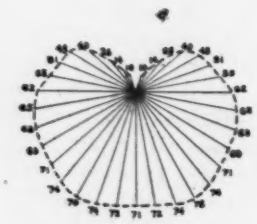


FIG 21
Curve of Inverted Burner with Opal Globe.

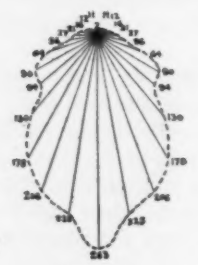


FIG. 22.
Curve of Inverted Burner with
Pagoda Reflector

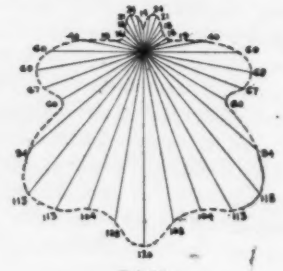


FIG. 23
Curve of Inverted Burner with
Holophane Globe

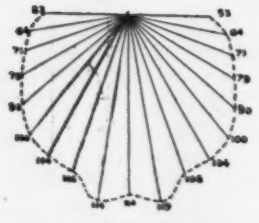


FIG 24
Curve of Inverted Burner with Flat Porcelain Reflector

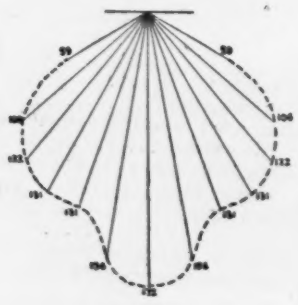


FIG. 25
Curve of Inverted Burner with 8 inch Deep Cone Reflector.

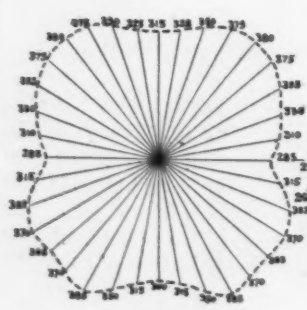


FIG. 26
Gas Arc No. 1
Curve of Horizontal Distribution

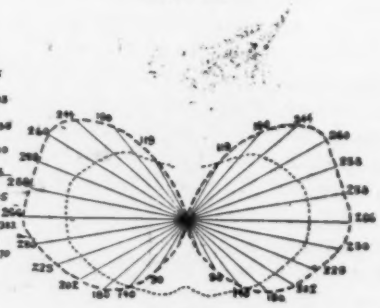


FIG. 28
Curves of Gas Arc No. 2
---- Clear Globe, No Reflector
..... Alabaster Globe, No Reflector

Figs. 4 to 28.—Spherical Candle Power Curves from Various Forms of Gas Lights.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

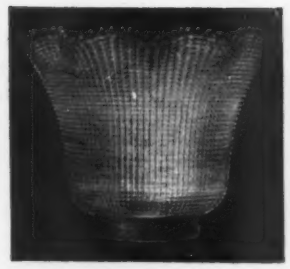


Fig. 10.

Fig. 12.

Fig. 17.

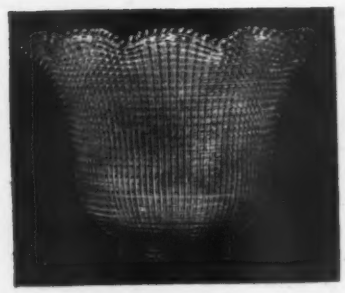


Fig. 11.

Fig. 26.

Fig. 18.

Fig. 19.

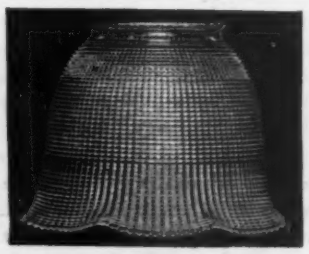


Fig. 23.

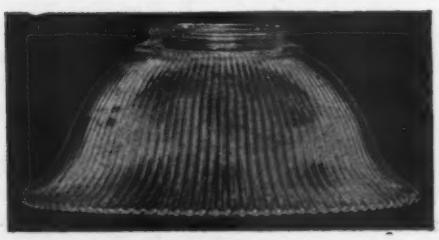


Fig. 22.

Figs. 5 to 26.—Globes and Shades used in Spherical Candle Power Tests of which the Curves are Given on the Opposite Page.

might state the way they were made. This arc that I have is a Welsbach arc. Mr. Lytle, the Welsbach engineer, was present when the tests were made, and the tests were made exactly as he wanted them. Therefore I cannot state exactly what they were, but there was the

ordinary standard equipment on the lamp. Just what the length of the mantle is I cannot state. But I believe they use center support mantles, do they not? You gentlemen are probably better informed on these details than I am.

Mr. T. D. Miller—I think they do. Did you say that was on New York gas?

Mr. Lansingh—Yes.

Mr. T. D. Miller—Do you know now what the calorific value of that gas was the day that test was made?

Mr. Lansingh—No, sir, I cannot say without referring to the electric testing laboratories. They can tell, probably. Personally I am not able to be present at these tests, owing to other business. (Continuing lecture.)

Fig. 28 shows the vertical distribution curve of gas arc No. 2 (the Humphrey), the dash line being the test with clear glass globe in the second plane and the dotted line the test with an alabaster globe in the third plane. No reflectors were used.

With this arc tests were made in three vertical planes, the third being halfway between the first two mentioned in the case of gas arc No. 1. In the third plane it is possible to see part of the fourth mantle.

The remarks with reference to the mean spherical candle power values of gas arc No. 1 apply also to this test. The results are as follows:

	Clear Globe without Reflector.		Alabaster Globe, Third Plane.
	First Plane.	Second Plane.	
Pressure	1.6	1.6	1.6
Consumption	18.0	18.0	19.0
Indicated mean spherical candle power	177.0	200.0	162.0
Indicated mean lower hemispherical candle power	168 0	185.0	166.0
Mean spherical candle power per cubic foot	9.8	11.1	8.5
Mean lower hemispherical candle power per cubic foot	9.3	10.3	8.7

Distribution.—Having given the photometric curves, it is possible to calculate the illumination in any part of a room we desire to light.

The unit of illumination is 1-foot candle. This can be defined as follows: If we had as a source of light, one standard candle, and held the object to be illuminated on a horizontal plane at a distance of 1 foot, the illumination on the subject would be 1-foot candle. If the light were of 16-candle power and we held the object to be illuminated 4 feet away we would again have 1-foot candle, inasmuch as the light varies inversely as the square of the distance. In order, therefore, to determine the illumination on any object, we simply have to divide the candle power of the source of light, when viewed from the point in question, by the square of the distance from the light to the point. Thus, in Fig. 29, if *A* is the source of light, *B* the point at which we

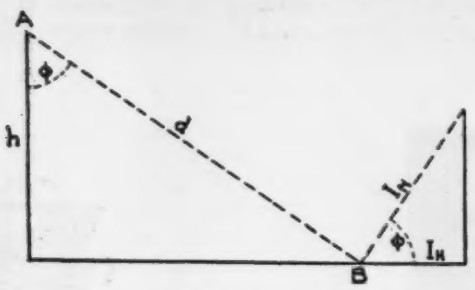


FIG. 29

Illustrating Method of Calculating Illumination

wish to determine the illumination, C P, the candle power of the light at the angle ϕ and d the distance from *A* to *B*, we will have an illumination

$$I_N = \frac{C\ P}{d^2}$$

This gives what is known as normal illumination, which is the effect we get when the rays of light strike perpendicularly to the object, that is to say, on a plane at right angles to *A B*. Thus, if we are reading in a church, we would naturally tip our book to such an angle, as to have the rays of light perpendicular, in order to obtain the maximum illumination. If, however, we should place our book flat and the light were not directly above it, we would not get as strong an illumination as before, and we should have to take into account the obliquity at which the rays of light strike the object. In this case we would have

$$I_H = \frac{C\ P}{d^2} \operatorname{Cos} \phi$$

where I_H is the horizontal illumination and Cos ϕ the multiplying factor to change from normal to horizontal illumination.

A more complete discussion of this subject cannot be entered into here, but for those who wish to pursue the subject further, reference is made to a paper by the writer before the Western Society of Engineers in April, 1903. It is sufficient to state that quite accurate results can be obtained by carefully designing the illumination of any given room, and that these results can be predetermined, so that before the installation is made, it will be possible to locate the lights so as to get very closely the desired illumination, although on account of the various variable conditions with gas burners it is not possible to determine results as accurately as with incandescent electric lights. As an example may be mentioned the illumination of a church designed by Prof. William Lincoln Smith. Calculations were first made and after the installation was completed, the illumination was measured with an illuminometer. The mean of over 80 readings showed a variation of a little over 6 per cent. from the calculated illumination, which means that, when the color scheme of a room is carefully considered, and the candle power and distribution curves of the sources of light are known, it is possible to design the illumination of a given room with about as much accuracy as enters into many problems of engineering work.

Examples.—A number of photographs of different installations of gas, both good and bad, are here given. These illustrations are selected from different types of subjects, so as to bring out the practical application of the foregoing principles in different classes of work.

Fig. 30 shows an ordinary bedroom with a 3 light chandelier, a side

Fig. 30.—A Good Example of Bedroom Lighting.

bracket next to the dresser and a bracket with a mantle burner in the corner. This seems to be a well lighted room. The chandelier gives good general illumination and the bracket next to the dresser is placed at the proper height to throw light on the person standing in front of the mirror. It would hardly be advisable to use a mantle burner on this bracket, unless a dense diffusing globe were used. The mantle burner in the corner, which is used for reading, is well placed and well equipped, except that a bobesche might be used to good advantage. This is not necessary, however, in case the person sits with his back to the light or the light is directly above the table as in this instance.

I have in mind also a well lighted dining room. The center arrangement, which can be pulled up and down, is equipped with an Argand burner, giving a soft, mellow light, while the opal dome acts as a good reflector. The other lights on the chandelier can be used when necessary for general illumination of the room. The Argand burner might be equipped with an opal or holophane bobesche to good advantage so as to protect the eyes. It should be noticed in such cases that where a center light is used, as well as other lights, it is not desirable to mix the color effects of mantle burners with open gas. The Argand burner, having practically the same color as an open flame, should be used in preference.

A certain church has bare gas brackets along the side walls and clusters of open flame burners over the organ and the choir. This is a

good example of what to avoid as far as the lighting of the front of the church is concerned. The lights there are placed directly where everybody must look at them during the entire length of the service. They are so situated as to be not only tiring to the eye, but owing to the eye working with a small aperture, the ability to see the preacher is materially decreased. A canvass among the congregation would doubtless disclose the fact that many people were subject to headache when in the church, and that, owing to the fact that it would be easier to close the eyes than to look at the lights, people were put to sleep, not necessarily by the sermon.

Fig. 31 shows a millinery store equipped with bare mantle burners.

Fig. 31.—Lighting with Clear Globes and Reflectors.

The distribution of light is good, as will be seen by referring to the distribution curve of this combination shown in Fig. 5, but the glare is inexcusable. This should be compared with Fig. 32, where the dis-

Fig. 32.—Lighting with Ornamental Globes.

tribution is not as good as in the former case, but where, owing to the dense globes used, we have nearly perfect diffusion and a light which is soft and easy to see by. It is much preferable to Fig. 31.

A barber shop was equipped with mantle burners, ground glass globes and flat fluted porcelain shades. Outside of the inartistic features, the lighting was fairly good.

Fig. 33 shows a small store lighted by a gas arc. It will be seen that the distribution of light in this case is fairly good, and that the light is placed so high as to be, generally speaking, out of range of the eye. This is a good example of how a gas arc can be used to advantage.

Fig. 34 shows a hat store lighted with gas arcs equipped with alabaster globes. In a store of this length, where the arcs are placed low, the use of alabaster globes is to be highly commended. This is another

Fig. 33.—Good Example of Gas Arc Store Lighting.

Fig. 34.—Opal Globe for Gas Arc Store Lighting.

example of where gas arcs are used effectively. Attention is called to the fact that an examination of this store will show that gas arcs, electric arcs and electric incandescent lamps are used. This is highly reprehensible if they are lighted at the same time. We should be very careful at all times never to mix our color effects. Nothing in the lighting line is perhaps less attractive than a place where we have the blue of an electric arc, the white of a mantle burner and the yellow of an incandescent electric lamp.

There is a certain office where, as far as the lighting arrangement is concerned, cheapness is evidenily the primary object. The lights are placed in such a position that when working at the desk one either sits in his own shadow, or else, as the light comes from the right, one has a constant shadow of the hand. In fact, the arrangement is about as poor as could be conceived of.

Fig. 35 has been selected as a splendid example of how not to do it. Almost all the principles of good illumination have been violated in this case. In the first place, the lights are so placed that, when a man looks up from his work, he will have the bare mantle glaring him directly in the eye. Second, the light from the lamps will strike the paper at such an angle that it will be regularly reflected, with a resultant glare which will soon produce injurious effects. Third, the light is not diffused, and the intensity, therefore, too high. Fourth, sufficient amount of light is not thrown on the work. In fact, this furnishes a very good example for a gas man to show his customers how not to light their desks. A slight change in the office arrangement would imme-

Fig. 35.—How Not to Do It.

diately rectify some of these errors; thus, if the tables were simply turned at right angles, the light would come from the left and slightly behind; it would be out of reach of the eyes of the man working on the table, but would nevertheless be visible to the man behind him, and should therefore be carefully shaded. It would be well in this case to use an oval dome and bobasche, which render the light soft to the man behind and give far more light on the work than the present equipment. For the same reason such an arrangement of tables would be better for daylight.

In lightnig a window, one of two objects is aimed at, either an illumination of the goods displayed, or else an attraction to the place by means of the lights.

As an example of window lighting, there is a hat store where the main illumination is furnished by electric lamps hidden in through reflectors, which are not visible outside. In order, however, to assist in attracting the passerby, lamps are placed in large diffusing globes, which, while adding but little to the illumination of the goods below, nevertheless serve to attract attention. Electricity only is used in this case, and it is simply given as an example of a combination of the two classes of window lig hting.

There are many problems connected with good illumination which the writer has not had even an opportunity to touch on in this paper. The subject is one of extreme breadth, and at the same time calls for the best of judgmeut in order to get good results. There are many unsolved problems, and the whole subject is, as yet, in a very much undeveloped state; but rapid advances are being made in the better use of our sources of light, to the advantage, not only of the consumer, but as it will prove in the long run, to the producer as well.

Discussion.

The President—I am sure we are all indebted to Mr. Lansingh for his courtesy in coming before us and giving his lecture. I notice it has been listened to with the closest attention, and there has been hardly a murmur or hardly a shuffle of the foot during the hour which it has taken. It is very flattering to Mr. Lansingh.

Mr. Mitchell—I think that this lecture is worth all of the expense we have been to in coming here, and the managers of the gas oompanies cannot do better than to have every one of their employees study it. I move, sir, that we extend a vote of thanks to the gentleman for his lecture.

The President—You have heard Mr. Mitchell's motion, that we extend a hearty vote of thanks to Mr. Lansingh for his lecture. (Adopted.) It is unanimous. Mr. Lansingh, we are indebted to you.

Mr. Lansingh—May I say just a word?

The President—Yes, sir.

Mr. Lansingh—There is so much interest taken in the subject of illumination that I should like to call the attention of the gentlemen present to the fact that there is now a Society of Illuminating Engineering, with headquarters in New York, and with branches in Boston, Philadelphia and Chicago. The society is formed of electrical men, of gas men, of acetylene men, of architects, of fixture dealers, of decorators, of everybody interested in the subject of illumination. Those who which to study the subject and be up to date in regard to this I would suggest should send their names to the secretary of the society. The dues are only $5 a year. There are monthly meetings held at the four places, which you, of course, are at liberty to attend at any time, and the transactions are published every month.

Mr. Elbert—Just one question I would like to ask Mr. Lansingh in reference to Fig. 3, where he shows a photometer and a mirror. Is it possible to get mirrors that will give a good standard all the time?

Mr. Lansingh—The mirrors used in this photometer are of heavy plate glass, and as the substitution method of photometry is used, that is to say, where one light is substituted for the other, the effect of the absorption of the mirrors is entirely obviated, the same as in the Matthews integrating photometer, where the mirrors do not enter into account at all, and therefore tests made with this method are perfectly correct. The Matthews integrating photometer, which is used largely in testing electric arc lamps, was used in testing the gas arcs, as far as their mean spherical and mean hemispherical candle powers were concerned, while the photometer shown on the screen was used for testing the smaller burners.

The President—The local Committee of Arrangements have requested me to remind you of the banquet this evening. You are all invited to be present, and we hope that you will come. The session this afternoon, which in view of the preparations for the banquet this evening will be held in what is called the transportion room on the floor below, will be called to order promptly at 2 o'clock. If there is no further business, I will now declare this morning session adjourned, to meet at that hour.

SECOND DAY—AFTERNOON SESSION.

The Association reassembled at 2 P.M.

The President—The first order of business will be the report of the Library Committee, Mr. Shelton, Chairman. In Mr. Shelton's absence it will be read by the Secretary.

REPORT OF THE LIBRARY COMMITTEE.

To the President and Membership, Western Gas Asoeiation: But few additions have been made to the library during the past year, and but few have availed themselves of the opportunity afforded.

F. H. SHELTON,
O. O. THWING,
JAS. W. DUNBAR, } Committee.

May 17, 1906.

The President—You have heard the reading of the report. What is your pleasure? If you have no objection we will take the report as read as adopted. The next report is that of the Committee on Municipal Ownership.

The Secretary—Mr. President and Gentlemen, I will state that this report was written before the action of the Association was taken in reference to merger.

REPORT OF THE COMMITTEE ON MUNICIPAL OWNERSHIP.

May 16, 1906.

Mr. President and Members of the Western Gas Association: Your Committee on Municipal Ownership respectfully beg leave to submit herewith a study of the growth of municipal ownership in the State of Massachusetts during the 11 years, 1894 to 1904, both inclusive. This paper was prepared by Mr. Fred. W. Wheeler, of Syracuse, N. Y., of your Committee, and on account of its length and number of tables contained therein we would recommend that it be referred to your Board of Directors, and if approved by them printed as part of the proceedings of this meeting.

Your Committee earnestly recommends to you the appointment of 3 members on a salary, who are to devote their entire time to this question; one member of the Committee to be a gas engineer, one an electrical engineer, one an expert accountant in gas, electric and municipal affairs. This Committee to visit municipal plants in this country and Europe for the purpose of obtaining data for comparison of operation with cities of this country.

It is further recommended that the Secretary's office be made a clearing house for the data collected, and that all information bearing on this subject be forwarded to him, and all requests for information be directed to him.

Respectfnlly submitted,

JOHN C. D. CLARK,
F. W. WHEELER,
JAMES W. DUNBAR, } Committee.

(To be Continued.)

[Prepared for the JOURNAL.]

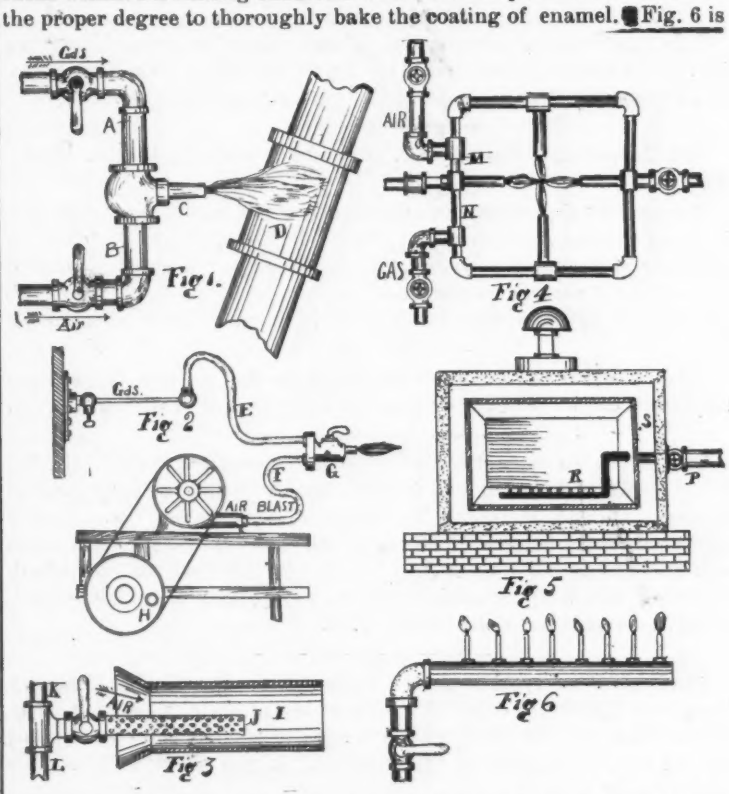
Increased Use of Illuminating Gas in the Industries.

By "TRAVELLER."

I find that the field for the employment of common house gas is developing steadily in the industrial shops of the country. A great many pieces of new labor-saving apparatus have been invented in the past few years, using gas as the motive power or operating agent. Repair shops, machine shops, printing offices, wood working establishments, automobile plants, bicycle institutions, laundries, iron works and the like have put in various equipments of machines and devices depending upon gas for the heat or propelling mechanism. We will refer in particular to the enamelling branches of the various industries in this article, and the enlarged field of operations with house gas in them. Enamelling is carried on to a great extent in automobile, carriage, harness, shoe and leather, plate ware and kindred departments. There are industrial shops springing up throughout the country which make a business of enamelling articles, just as shops have been in existence that make a business of plating your worn silver utensils. In the department of enamelling gas is employed for several purposes. First old material or surfacing has to be scored off from the parts. There are ingredient baths to do this, and also means of grating it off with roughing wheels. The flame method is used with gas as in Fig. 1.

A common way is to draw the gas direct from one of the gas jets of the interior. But in recent times means are taken not to interfere with the jets. When you put a rubber tube over a burner, you shut the burner off as a means of lighting. Besides, the volume of gas possible to receive through the limited passage of a single ordinary burner may be too small to feed the burner in combination with the air blast. Hence, in many places they are making arrangements for a gas supply, just the same as they put in additional supply wires in view of making a connection for some machine or device for an electrical current. Many suppose that they can unscrew the globe of an electrical light and insert the plug of the wire of a device to be operated by electrical power. But the slender wire feeding the light is not ample for this and the wire will heat and burn out. Then you find you have to go back to the switch board and either fuse up, or connect direct to the main. Just so with the gas jets. Do not expect good results from the little gas obtainable from the single burner. Try to get to a main. Returning to the plan in Fig. 1 we find that the gas pipe feed is marked *A* and the air blast *B*. The air and the gas combine in the nozzle *C*, where ignition occurs and a brilliant and heating flame results. You need to get some force with your gas, to make the mixture complete, and to drive the flame to the seat as at *D*. This is done with the air blast of the character exhibited in Fig. 2. You will need to rig up a blower. We show the wheel of the blower and the blower itself as attached to the bench. One side of the blower is removed for the purpose of illutrating the interior wheel plan. You can buy the blowers ready made. The blow can be operated from a shaft overhead or underneath as by the wheel *H*. It is better to run the wheel by power. If necessary however, a hand crank can be put on and you can have a lad turn the wheel. The connecting belt to the blower wheel causes the latter to revolve. The paddles draw in the air and discharge it through the blast pipe *F* to the combining outlet *G*. Then you get your gas supply from a nearby gas jet or better still by attaching to a special connection at a main, and use the hose pipe or other rubber pipe *E* to connect to the union *G*. This gives you the desired combination to work with and quite a good and intense flame result. Fig. 3 explains a good plan of arrangement for the enamel oven heating pipes. You will need a system of three to five multiple burners to order to get a steady and strong heat for the baking apartments of the enamelling ovens. The burners proper consist of 1 to 2-inch pipes, about 20 inches long, with the inner ends *J* closed. You should bore these pipes with ⅛-inch holes in rows as shown. The outer pipe is simply a protection, and is open at the end to let the volume of heat pass out into the space of the oven. The air passage is the space between the inner pipe and the wall of the larger one. *K* and *L* mark the combination air blast and gas pipes. The flames are obtained at each of the holes, that a good distribution of heat results inside the pipe *F*, and the heated air serves to bake the enamelled surfaces. Sometimes the arrangement is as exhibited in Fig. 4 for the interior of the oven. The gas and the air pipes are designated accordingly. The passages lead to the common central pipe where the air and gas unite as at *N* and *M*. The contents of the pipe circulate and the burners emit the same so that at ignition the flames combine at a central point as at *O*. The arrangement of the gas and air supply pipe for the completed oven is presented in Fig. 5. The ovens are necessarily constructed of heat proof material, so as to retain the heat as much as possible. Hence there are double thicknesses of walls in most cases. Sometimes one thickness of wall is filled in with asbestos. Ashes are also used as a packing on the sides, top and bottom for heat retaining purposes. The method of introducing the gas heating device in this case involves the insertion of the pipe *B* through one of the side walls as shown. The passage between the appartments *S* is passed through and the pipe enters the main chamber as at *R*.

Here the pipe depresses to the bottom of the chamber and as the upper side of the pipe is perforated for burner holes, a number of jets can be burned. Several of these pipes arranged side by side in the apartment answer all purposes for a perfect heating capacity for the enamelled goods. The latter are dipped in the enamelling tanks, permitted to drain in tubs, and then the parts are hung on hooks or placed upon racks within the heating chambers where the temperature is heated to the proper degree to thoroughly bake the coating of enamel. Fig. 6 is



another arrangement of jet adjustment for a continuous line of jets on a single pipe for heating purposes.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Laclede Gas Light Company, of St. Louis, Mo., has thrown up its hands in despair of the present municipal assembly, and has abandoned, at least temporarily, its project to erect a $25,000,000 plant on the Mississippi river inSouth St. Louis, between Catalan street and the River des Peres.

THE final details of the transfer of the property of the Pottsville (Pa.) Union Traction Company, the Edison Illuminating Company and the Tamaqua and Lansford Street Railway Company, were cousummated at the offices of the Real Estate Title Company, at Philadelphia. The papers were signed and these corporations now pass into the hands of the syndicate. The U.G.I. is supposed to control.

THE employees of the Gas Company at Long Branch, N. J., presented Mr. W. B. Tuttle, with a gun and a Masonic ring on his leaving Long Branch to be Manager at San Antonia, Tex.

CHARLOTTEVILLE, Va., will either sell or lease its gas plant.

THE Kerr Murray Manufacturing Company, of Fort Wayne, Ind., has just closed a contract representing $19,000 with the Iowa City Gas Company, of Iowa City, Ia., for the manufacture of a 2-lift gasholder and steel tank with a capacity of turning out 150,000 cubic feet of gas, and 78 feet in diameter. It is also doing work for the Western Electric Company at Chicago, the Gas and Electric Company at Denver, Col., the Hastings Gas Company at Hastings, Neb., Newark,

N. J. Bloomington, Ills., Grand Rapids, Mich., Olewein, Ia., Kirksville, Mo., and Muskogee, I. T.

THE Brandywine Electric and Gas Company are again hammering Wilmington, Del., for a franchise.

THE Hanover (Pa.) Gas Company, a corporation organized several years ago to manufacture and sell gas for lighting and heating purposes in the boroughs of Hanover and McSherrystown and adjacent territory, has issued a second mortgage in the sum of $150,000 for the extension of its business. The bonds will be issued with the Union Trust Company, Harrisburg, as trustee, making the total indebtedness of the company $225,000. The officers of the Hanover Gas Company are R. H. Dutton, President, and L. R. Dutton, Secretary.

S. LEWIS CRAMER, Manager of the Peoples Gas Company, of Reading, Pa., will retire, to be succeeded by Mr. Williams, of New York State. Mr. Cramer has been identified with the Company since 1887.

THE Council at Jackson, Mich, adopted a 90-cent rate for that town.

A LEAKING valve caused an exploison in the blast pipe at the new gas house of the San Antonio (Tex.) Gas and Electric Light Company on Medina and Matamoros streets. Much of the machinery was damaged and all of the window panes broken. Part of the roof was blown off. Mr. Wm. B. Tuttle, who is to go there as Manager, will have plenty to do.

A. GUY PICKENS, has been promoted to the position of Assistant Superintendent of the United States Gas Company, of Waterbury, Conn.

THERE was but one bid made for the Matteawan and Fishkill (N. Y.) Gas Company, and that was $30,000, from a committee consisting of Clarence G. and Harry D. Thompson, of New Haven, Conn., representing the bond holders. The conditions of the sale are that the plant can be negotiated for up to July 27th, when the deed shall be passed. This date can be postponed, however, by application to the referee, Joseph Morschauser, until October 27th.

ARTICLES of incorporation of the Lapeer (Mich) Gas-Electric Company have been filed in the office of the Secretary of State at Lansing. Capitalization is $60,000, of which $45,000 worth of stock is to be disposed of and $15,000 retained in the treasury. A gas plant will be built immediately.

THE Milwaukee (Wis) Gas Company, will erect a water gas set in the near future.

THE Travers City (Mich) Gas Company has made a reduction in the price of gas. Heretofore the price of $1.35 per 1,000 feet was subject to a discount of 15 cents per 1,000 if paid before the 15th of the month. The discount is now 25 cents.

A SPECIAL meeting of the Town Council was held at Lonsdale, R.I. The business of the meeting was to sign the contract with the Pawtucket Gas Company, giving that concern an exclusive franchise in the town for a period of 15 years, in return for which the residents of the town are to get lower rates for gas consumption.

THE output of Boston Consolidated Gas for June amounted to 232,160,000 cubic feet as compared with 215,553,000 cubic feet in June last year, an increase of 7.7 per cent.

W. PROUT, of Miami, Fla., and his associates, H. M. Vancourt, John P. Mathiew and H. G. Vancourt, of Philadelphia, compose a new Gas Company, with a capital of $100,000, that will operate a large gas plant in the city of Miami. The plant will be in operation by next December.

THE stockholder of the Winston-Salem (N.C.) Gas Company met, organized and elected the following officers: President, William Mainland, of Oshkosh, Wis. Vice-President, Judge E. B. Jones, of Winston-Salem; Secretary and Treasurer, St. Clair Mainland, of Oshkosh, Wis. The above officers, with Mr. Joe Jacobs, and Mr. J. C. Thompson, of Oshkosh, Wis., compose the Board of Directors. It was decided to spend several thousand dollars on the gas plant within the next 90 days. The first work to be done is an extension of the main on West 5th street from Summit to the city line. The capital stock of the Company is $100,000.

NELSON P. HULST, formerly manager of the Oliver iron mine has been chosen a Director in the Milwaukee (Wis.) Gas Light Company, to succeed Col.E. G. Pratt. Other Directors chosen are: J. P. Murphy, Wilmer Sieg, S. E. Glass, Ira B. Smith, H. A. J. Luedke, Oliver C. Fuller, S. M. Green and Emerson McMillan.

THE Shawnee (Okla.) Gas and Electric Light Company has just completed a coal gas plant at a cost of $150,000, with 36 miles of mains extending over the city. The gas was turned on, and over 1,000 cooking stoves are now being supplied with the fuel gas, while a large number of lights are in service. The plant is one of the most modern in the Southwest.

THE price of gas in Attleboro, has been reduced 20 cents per 1,000, the reduction to go into effect from July 1. The price of gas under this new regulation is $1.30.

MR. E. B. MOONEY, who has been in the employ of the Brockton (Mass.) Gas Light Company for the past 19 years, has resigned his position as Business Manager of the Company, the resignation to take effect August 1.

MR. B. W. PERKINS has tendered his resignation as Superintendent of the South Bend (Ind.) Fuel and Gas Company, to take a similar position with the Altoona (Pa) Gas Company. Mr. Perkins has spent the greater part of his life in South Bend. He went there as a boy 30 years ago, and 10 years later succeeded his father in the responsible position he now resigns.

THE Woonsocket, R. I., Council is trying to secure the same rate that the Pawtucket Company gives Pawtucket and is offering Lincoln and Cumberland.

LOUISVILLE, KY., contemplates paying a 7 per cent. dividend this year.

MR. GEO. STAUGH, of Independence, Kas., has been granted a gas franchise at Rich Hill, Mo.

MR. OSCAR E. BLAND, representing a large number of the creditors of the Linton (Ind.) Gas Company, asked that a Receiver be appointed for the Company.

A MEETING of the stockholders and directors of the Akron (O.) Gas Company has been held, when a new organization was effected and the franchise ordinance passed by the city council June 18 was accepted. Mr. John R. Walsh, the Chicago magnate, remains at the head of the Company as President. The reorganization of the Company brought about a few changes, the principal one being that S. G. Rogers becomes Secretary of the Company, and A. B. Eilbeck, Vice-President, in place of Col. George T. Perkins.

THE Morristown (N. J.) Gas Company had a slight fire which damaged its property to the extent of about $1,000.

THE stokers who were called out by the Brockton, Mass., Stationary Firemen's Union, returned to work without the approbation of the Union. They seem to be convinced that they had been well treated by the Gas Company.

THE erection of the gas plant at Amarillo, Tex., has been started.

THE Gas Machinery Company, of Cleveland, O., has been awarded a contract by the Boston (Mass.) Gas Company to instal at their plants, coal and water gas P. & A. tar extractors having a combined capacity of 24,000,000 cubic feet per day.

THE Michigan Gas Association holds its meeting at Grand Rapids, Mich., on Sept. 12, 13 and 14, 1906. The Secretary has mailed a notice to its members giving cogent reasons for a full attendance.

MR. J. H. T. MARTIN, of New York city, has purchased the Gas Company at New Bern, N. C. Mr. Martin is President and Mr. J. M. Cox, Manager. The latter was formerly with the Peoples Light Company, of Davenport, Ia., and later at Muscatine, Ia.

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JULY 16, 1906.

The Market for Gas Securities.

At the auction sale on July 11th $10,000 Consolidated Electric Light and Power Company's general mortgage 4½ per cent. bonds, of Baltimore, were sold at 85½ and accrued interest. It is stated that the gross earnings of the Peoples Gas Company, of Chicago, for the half year ended June 30, show an increase of between 10 and 15 per cent. This does not quite offset the reduction in the price of gas that went into effect Feb. 1, but it is thought that the last 6 months of the year will make an average large enough to completely retrieve the gross of 1905. Of course, the net showing must necessarily be smaller, but at all events it will be ample to maintain 5 per cent. dividends.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 16.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $1 00 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	136½	137⅛
Central Union, Bonds, 5's	3,000,000	1,000	101	104
Equitable Bonds, 6's	1,000,000	1,000	..	105
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	225	250
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	103	105
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's.	1,250,000	1,000	101	103
New York and East River .. Bonds, 1st 5's	3,500,000	1,000	108	111
" 1st Con. 5's	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	120	130
" " Bonds(5's)	15 000,000	1,000	108	112
Bay State	50,000,000	50	5/16	⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	52	55
2d " " "	3,000.000	1.000	47½	50
Buffalo City Gas Co.	5,500,000	100	9	10
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	106¾
Cincinnati Gas and Electric Co.	29,500,000	100	103½	103¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,036,500	100	107¼	108
Consumers, Toronto	2,300,000	50	200	204
Consolidated, Baltimore	11,000,000	100	..	88
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	107½	108¼
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	105
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	104	104¼
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Massachusetts Gas Companies of Boston	25,000,000	100	54	54¼
Preferred	95,000,000	100	87½	88
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	6,000,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	88¼	88½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104½	105¼
San Francisco, Cal.	15,800,000	100	..	..
St. Joseph Gas Co. 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,500,000	20	300½	301
First mortgage 6's	500,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	500,000	50	230	..

Advertisers' Index.

GAS ENGINEERS. Page

A. E. Boardman, New York City 105
Baxter & Young, Detroit, Mich 123
B. E. Chollar, St. Louis, Mo 116
Cruse-Kemper Co., Philadelphia, Pa 112
David Leavitt Hough, New York City 123
Davis & Farnum Mfg. Co., Waltham, Mass 124
Economical Gas Apparatus Construc'n Co., Toronto, Ont 105
Frank D. Moses, Trenton, N. J 124
Fred. Bredel Co., Milwaukee, Wis 122
Frederic Egner, Washington, D. C 128
H. M. Byllesby & Co., Chicago, Ills 111
Humphreys & Glasgow, New York City 125
Isbell-Porter Co., Newark, N J 112
J. F. W. Jost, Philadelphia, Pa 113
Kerr Murray Mfg. Co., Fort Wayne, Ind 124
The Gas Machinery Co., Cleveland, O 108
The Jeffrey Manufacturing Co., Columbus, O 122
United Gas Improvement Co., Philadelphia, Pa 119
Western Gas Construction Co., Fort Wayne, Ind. 88

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City 105
Bartlett, Hayward & Co., Baltimore, Md 125
Baxter & Young, Detroit, Mich 123
Connelly Iron Sponge & Governor Co., New York City 121
Continental Iron Works, Brooklyn, N. Y 126
Cruse-Kemper Co., Philadelphia, Pa 112
Davis and Farnum Mfg. Co., Waltham, Mass 124
Deily & Fowler, Philadelphia, Pa 128
Economical Gas Apparatus Construc'n Co., Toronto, Ont 105
Empire Gas Construction & Improvement Co., N. Y. City 113
Frank D. Moses, Trenton, N. J 124
Fred. Bredel Co., Milwaukee, Wis 122
G. Shepard Page's Sons, New York City 123
Humphreys & Glasgow, New York City 125
Isbell-Porter Company, New York City 112
Kerr Murray Mfg. Co., Fort Wayne, Ind 124
Lloyd Construction Co., Detroit, Mich 114
Logan Iron Works, Brooklyn, N. Y 128
Quintard Iron Works, New York City 125
R. D. Wood & Co., Philadelphia, Pa 126
Riter-Conley Mfg. Co., Pittsburgh, Pa 127
Stacey Mfg. Co., Cincinnati, O 127
The Gas Machinery Co., Cleveland, O 108
The Jeffrey Manufacturing Co., Columbus, O 122
United Gas Improvement Co., Philadelphia, Pa 119
Western Gas Construction Co., Fort Wayne, Ind 88

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md 125
B. E. Chollar, St. Louis, Mo 116
California Light and Fuel Co., San Francisco, Cal 126
Economical Gas Apparatus Construc'n Co, Toronto, Ont. 105
Fred. Bredel Co., Milwaukee, Wis 122
Humphreys & Glasgow, New York City 127
The Gas Machinery Co., Cleveland, O 108
United Gas Improvement Co., Philadelphia, Pa 119
Western Gas Construction Co., Fort Wayne, Ind 88

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N.Y 126
Cruse-Kemper Co., Philadelphia, Pa 112
Davis & Farnum Mfg. Co., Waltham, Mass 124
Economical Gas Apparatus Construc'n Co., Toronto, Ont 105
Fred. Bredel Co., Milwaukee, Wis 122
Isbell-Porter Co., Newark, N. J 112
Kerr Murray Mfg. Co., Fort Wayne, Ind 124
Logan Iron Works, Brooklyn, N. Y 128
R. D. Wood & Co., Philadelphia, Pa 126
Riter-Conley Mfg. Co., Pittsburgh, Pa 127
Stacey Mfg. Co., Cincinnati, O 127
The Gas Machinery Co., Cleveland, O 108
Western Gas Construction Co., Fort Wayne, Ind 88

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construc'n Co., Toronto, Ont. 105
R. D. Wood & Co., Philadelphia, Pa 126

TAR AND CARBONIC ACID EXTRACTOR.

Economical Gas Apparatus Construc'n Co., Toronto, Ont. 105
Fred. Bredel Co., Milwaukee, Wis 122
Isbell-Porter Co., Newark, N. J 112
Kerr Murray Mfg. Co., Fort Wayne, Ind 124
Stacey Mfg. Co., Cincinnati, O 127
The Gas Machinery Co., Cleveland, O 108
Western Gas Construction Co., Fort Wayne, Ind 88

AMMONIA CONCENTRATORS.

Fred. Bredel Co., Milwaukee, Wis 122
Kerr Murray Mfg. Co., Fort Wayne, Ind 124
Michigan Ammonia Works, Detroit, Mich 104
The Gas Machinery Co., Cleveland, O 108
Western Gas Construction Co., Fort Wayne, Ind 88

GAS METERS.

American Meter Co., New York and Philadelphia. 131
Detroit Meter Company, Detroit, Mich..... 87
D. McDonald & Co., Albany, N. Y..... 129
Helme & McIlhenny, Philadelphia, Pa..... 131
John J. Griffin & Co., Philadelphia, Pa. 132
Keystone Meter Co., Royersford, Pa..... 128
Maryland Meter and Mfg. Co., Baltimore, Md..... 128
Metric Metal Co., Erie, Pa..... 129
Nathaniel Tufts Meter Co., Boston, Mass..... 128
New York Improved Meter Co., New York City 130
Pittsburgh Meter Co., Pittsburgh, Pa..... 129
Rotary Meter Co., New York City..... 107

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 131
D. McDonald & Co., Albany, N. Y..... 129
Helme & McIlhenny, Philadelphia, Pa..... 131
John J. Griffin & Co., Philadelphia, Pa..... 132
Keystone Meter Co., Royersford, Pa..... 131
Nathaniel Tufts Meter Co., Boston, Mass..... 130
New York Improved Meter Co., New York City..... 130
Pittsburgh Meter Co., Pittsburgh, Pa..... 129

PREPAYMENT METER ATTACHMENTS.

New York Improved Meter Co., New York City 130
Reeves Mfg. Co., New Haven, Conn. 127

WATER METERS.

Pittsburgh Meter Co., Pittsburgh, Pa..... 129

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Donaldson Iron Co., Emaus, Pa..... 116
Economical Gas Apparatus Construc'n Co., Toronto, Ont. 105
R. D. Wood & Co., Philadelphia, Pa..... 126
Warren Foundry and Machine Co., New York City..... 116

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 122
Perkins Co., New York City..... 122
Westmoreland Gas Coal Co., Philadelphia, Pa 123

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa..... 110

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., New York City..... 118

MAIN AND SERVICE LAYING.

Sullivan Bros., Flushing, N. Y..... 66

GAS TAPPING MACHINES.

George Light, Dayton, O..... 116
H. Mueller Manufacturing Co., Decatur, Ills..... 114

CANNEL COALS.

Perkins & Co., New York City..... 122

STOKING MACHINERY.

G. A. Bronder, New York City..... 123

CONVEYORS.

Adam Weber Sons, New York City..... 120
Cruse-Kemper Co., Philadelphia, Pa..... 119
C. W. Hunt Company, New York City..... 118
Dodge Coal Storage Co., New York City..... 116
Economical Gas Apparatus Construc'n Co., Toronto, Ont 105
Fred. Bredel Co., Milwaukee, Wis..... 122
G. A. Bronder, New York City..... 123
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
The Gas Machinery Co., Cleveland, O..... 108
The Jeffrey Manufacturing Co., Columbus, O..... 122
The Link-Belt Engineering Co., Philadelphia, Pa..... 115
The Link-Belt Machinery Co., Chicago, Ills 116
Western Gas Construction Co., Fort Wayne, Ind..... 88

CHARGING BARROWS & COAL WAGONS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 123
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
Stacey Mfg. Co., Cincinnati, O..... 127

GAS ENRICHERS.

Standard Oil Co., New York City. 79
Sun Company, Pittsburgh, Pa..... 123
The Sun Oil Co., Pittsburgh, Pa..... 123

COKE CRUSHERS.

C. M. Keller, Columbus, Ind..... 123
Fred. Bredel Co., Milwaukee, Wis..... 122
The Jeffrey Manufacturing Co., Columbus, O..... 122

GAS METER CONNECTIONS.

H. Mueller Manufacturing Co., Decatur, Ills..... 114

GAS COCKS.

H. Mueller Manufacturing Co., Decatur, Ills..... 114

GAS GAUGES.

The Bristol Co. Waterbury, Conn..... 108

GAS GOVERNORS.

Connelly Iron Sponge & Governor Co., New York City. 121
Fred. Bredel Co., Milwaukee, Wis. 122
Isbell-Porter Co., Newark, N. J..... 112
Johnson-Reynolds Co., Anderson, Ind..... 123
Pittsburgh Meter Co., Pittsburgh, Pa..... 129
R. D. Wood & Co., Philadelphia, Pa..... 126

CEMENTS.

C. L. Gerould, Pittsburgh, Pa..... 120
F. W. Stanley, New York City..... 130

RETORTS AND FIREBRICKS.

Adam Weber Sons (Albert J. Weber's Construction).. 120
Baltimore Retort and Firebrick Co., Baltimore, Md.. 120
Brooklyn Firebrick Works, Brooklyn, N.Y..... 120
Henry Maurer & Son, New York City..... 130
James Gardner, Jr., Co., Pittsburgh, Pa..... 130
J. H. Gautier & Co., Jersey City, N. J..... 130
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 108
Missouri Firebrick Co., St. Louis, Mo..... 120
National Pyrogranit Co., New York City..... 120
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.... 121
St. Louis Gas Construction Co., St. Louis, Mo..... 120

(*Continued on page 105.*)

NOTICE!

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(*Concluded from page* 104.)

INCLINED RETORTS.

Adam Weber Sons (Graham-Morton [England] System) 120
Baltimore Retort and Firebrick Co., Baltimore, Md..... 120
Fred. Bredel Co., Milwaukee, Wis..... 122
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 121
St. Louis Gas Construction Co., St. Louis, Mo..... 120

VERTICAL S'S.

Adam Weber Sons, New York City..... 120
Connelly Iron Sponge & Gov.Co. (Drake's [Eng.] System) 121
Fred. Bredel Co., Milwaukee, Wis..... 122
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 121
St. Louis Gas Construction Co., St. Louis, Mo..... 120

VERTICAL RETORTS, CHARGING AND DISCHARGING VERTICALLY.

Adam Weber Sons, New York City..... 120

REGENERATIVE FURNACES.

Adam Weber Sons, New York City..... 120
Baltimore Retort and Firebrick Co., Baltimore, Md..... 120
Bartlett, Hayward & Co., Baltimore, Md..... 125
Fred. Bredel Co., Milwaukee, Wis..... 122
J. H Gautier & Co., Jersey City, N. J..... 120
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 108
Missouri Firebrick Co., St. Louis, Mo..... 120
Parker-Russell Mining and Mfg. Co., St Louis, Mo. ... 121
St. Louis Gas Construction Co., St. Louis, Mo..... 120

SELF-SEALING MOUTHPIECE DOORS.

Continental Iron Works, Brooklyn, N. Y..... 126
Davis & Farnum Mfg Co., Waltham, Mass..... 124
Fred. Bredel Co., Milwaukee, Wis..... 122
Isbell-Porter Co., Newark, N. J..... 112
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
Logan Iron Works, Brooklyn, N. Y..... 128
R. D. Wood & Co., Philadelphia, Pa..... 126
Stacey Mfg. Co., Cincinnati, O..... 127
The Gas Machinery Co., Cleveland, O..... 108
Western Gas Construction Co., Fort Wayne, Ind..... 88

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City..... 120

INCANDESCENT GAS LAMPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 110
General Gas Light Co., Kalamazoo, Mich..... 109
Geo. G. Ramsdell, New York City..... 942
Welsbach Company, Gloucester, N. J..... 118

BURNERS.

D. M. Steward Mfg. Co., Chattanooga, Tenn.. .. 1 0
Wm. M. Crane Co., New York City.. ... 110

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn 110

STREET LAMPS.

Thos. T. W. Miner, New York City..... 116
Welsbach Street Lighting Co., New York and Phila... 118

PURIFIERS.

Connelly Iron Sponge & Governor Co., New York City.. 121
Cruse-Kemper Co., Philadelphia, Pa..... 112
Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Fred. Bredel Co., Milwaukee, Wis. 122
Isbell-Porter Co., Newark, N. J..... 112
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
R. D. Wood & Co., Philadelphia, Pa..... 128
Stacey Mfg. Co., Cincinnati, O.. 127
Western Gas Construction Co., Fort Wayne, Ind. 88

PURIFYING MATERIALS.

Connelly Iron Sponge & Governor Co., New York City.. 121
Greenpoint Chemical Works, Brooklyn, N. Y..... 104

VALVES.

Continental Iron Works, Brooklyn, N. Y.. 126
Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Economical Gas Apparatus Construc'n Co, Toronto, Ont 105
Isbell-Porter Co., Newark, N. J..... 112
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
Ludlow Valve Manufacturing Co., Troy, N. Y..... 113
R. D. Wood & Co., Philadelphia, Pa..... 128
Stacey Mfg. Co., Cincinnati, O..... 127
The P. H. & F. M. Roots Co., Connersville, Ind..... 115
Western Gas Construction Co., Fort Wayne, Ind..... 88

EXHAUSTERS.

Connelly Iron Sponge & Governor Co . New York City.. 121
Connersville Blower Co., Connersville, Ind 106
Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Isbell-Porter Company, Newark, N. J..... 112
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
The P. H. & F. M. Roots Co., Connersville, Ind..... 115

PURIFIER SCREENS.

John Cabot, Hoboken, N. J..... 108
Western Gas Construction Co., Fort Wayne, Ind..... 88

GAS STOVES.

American Meter Co., New York and Philadelphia 131
Keystone Meter Co., Royersford, Pa..... 140
Maryland Meter & Manufacturing Co., Baltimore, Md.. 130
Nathaniel Tufts Meter Co., Boston, Mass..... 130

HOT WATER HEATERS.

Humphrey Co., Kalamazoo, Mich..... 111

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N.Y..... 116

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 125
Continental Iron Works, Brooklyn, N. Y..... 126
Cruse-Kemper Co., Philadelphia, Pa. 112
Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Deily & Fowler, Philadelphia, Pa..... 128
Economical Gas Apparatus Construc'n Co., Toronto, Ont 105
Kerr Murray Mfg. Co., Fort Wayne, Ind. 124
Logan Iron Works, Brooklyn, N. Y..... 128
R. D. Wood & Co., Philadelphia, Pa. 126
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 127
Stacey Mfg Co., Cincinnati, O..... 127
Western Gas Construction Co., Fort Wayne, Ind..... 88

STORAGE TANKS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 124
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 124
Stacey Mfg. Co., Cincinnati, O..... 127
Western Gas Construction Co., Fort Wayne, Ind..... 88

PAINTS.

American Standard Composition Co., New York City.. 111

PATENTS, TRADE-MARKS, COPYRIGHTS.

Royal E. Burnham, Washington, D. C. 108

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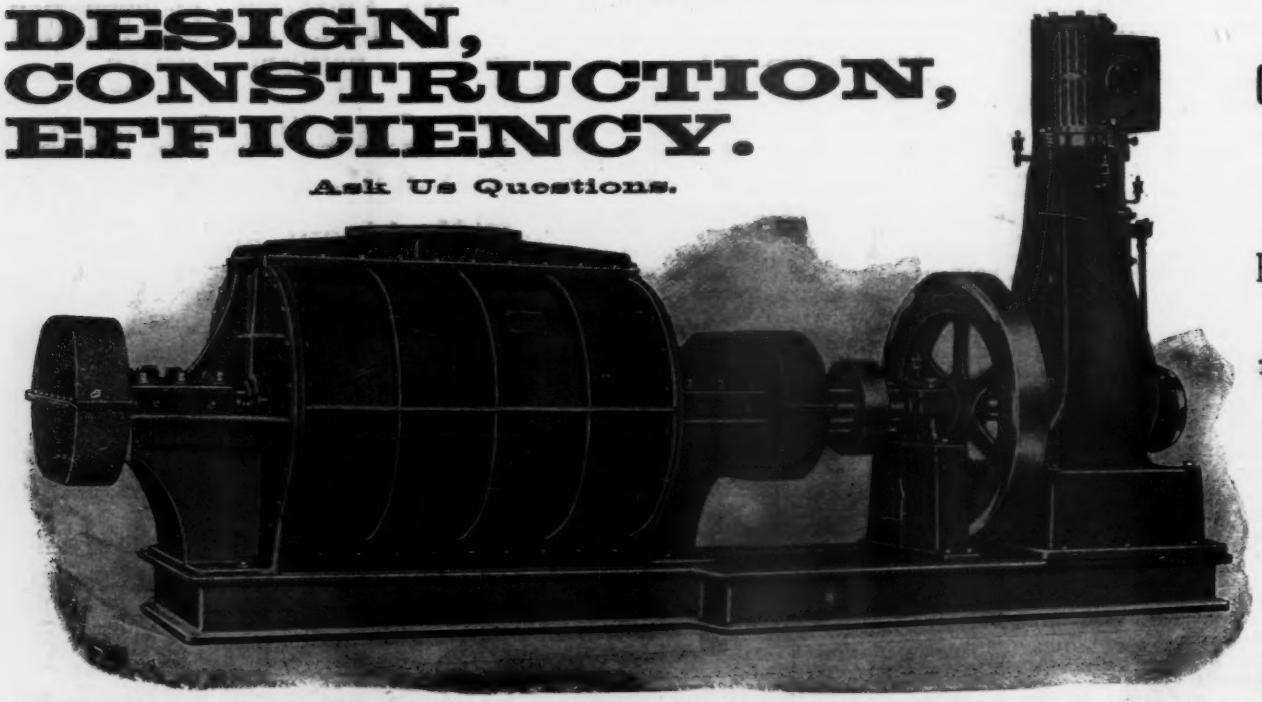

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DEAR SIRS:

In answer to yours of the 27th March, I have pleasure in stating that we have had an 80,000 cu. ft. per hour Rotary Station Meter in use in connection with our Water Gas Plant for almost 18 months; during the greater part of this time we worked in series with our ordinary station meter, and found its registration accurate. I am so satisfied with it that I am about to place an order with the firm for a meter to pass 180,000 cu. ft. per hour of coal gas.

Yours faithfully, _____

DEAR SIRS:

In reply to your enquiry of the 27th March *re* Rotary Meter, I have not the slightest hesitation in stating that the meter we have in use here is giving every satisfaction.

It is 15,000 cu. ft. per hour and fixed at the outlet of Condensers of our Carburetted Water Gas Plant, and of course in the inlet of the Relief Holder, and is working under extreme conditions.

It is fixed underground, and since we have had it, *viz.*, 3 years, we have only taken it out once for examination (and this out of curiosity); as you will quite understand, there is a lot of oil, tar, etc., in contact with the meter at this point, and we thought it might be getting clogged up, but were pleased to find that such was not the case.

From our experience we have not the slightest hesitation in recommending its adoption to all gas makers.

I shall be pleased to reply further if necessary.

Yours very faithfully, _____

GENTLEMEN:

In reply to yours of March 27th respecting the Rotary Station Meter in use at these Works, I beg to inform you that the same has given every satisfaction. The meter has been registering the whole of the gas made at our Inclined Retort Section for the past 2½ years, and up to the present time we have not had the slightest trouble. The capacity of our meter is 100,000 cu. ft. per hour.

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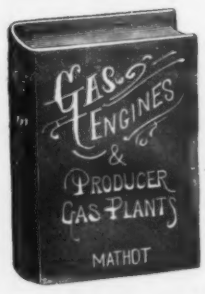

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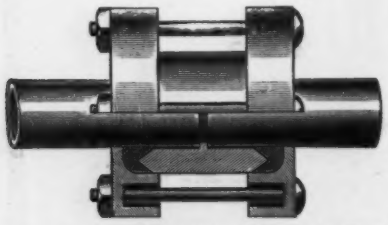
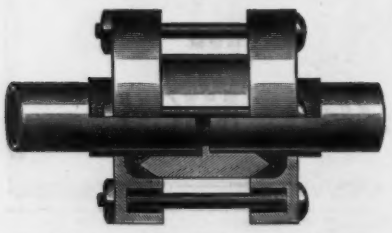
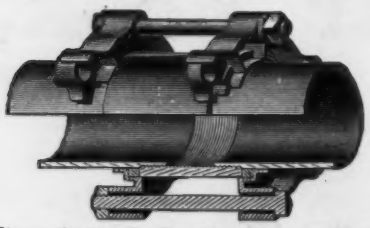


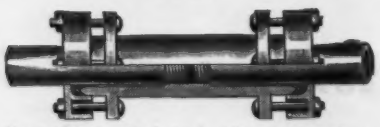
Regular Coupling, Style 1, for Plain End Wrought Iron Pipe.



Insulating Coupling, Style 5, for Plain End Wrought Iron Pipe.



Clamp, Style 4, for Repairing Leaks on Screw Collar.



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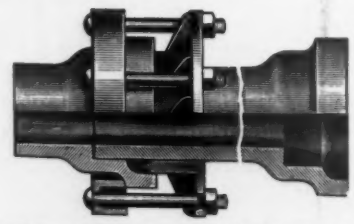
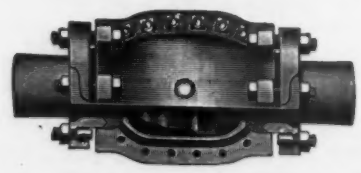
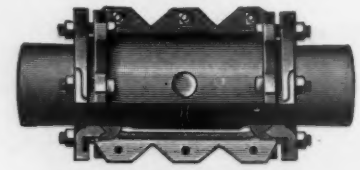


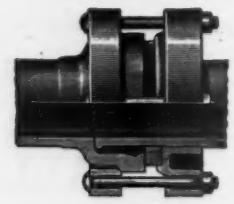
Coupling, Style 9, for Special Style Cast Iron Pipe.



Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.



Split Sleeve for Repairing Broken or Cracked Cast Iron Pipe.



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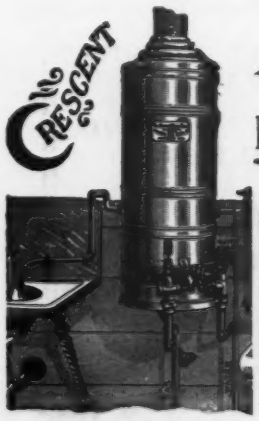

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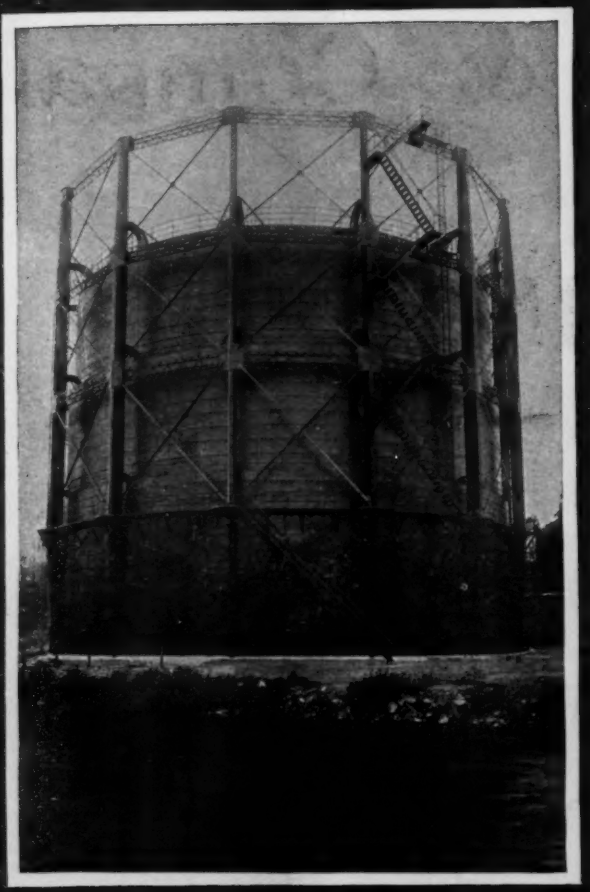

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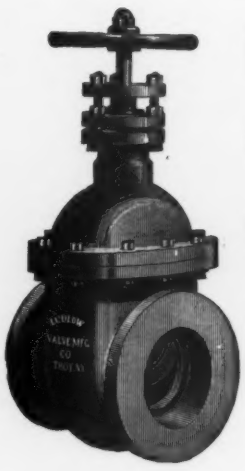

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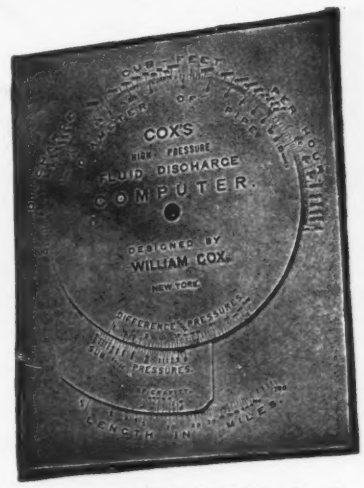

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Discharge in cubic feet per hour at atmospheric pressure $= 33.3 \sqrt{\frac{d^5 \times (p_1^2 - p_2^2)}{L \times w}}$

Where

d = diameter of pipe in inches,
p_1 = absolute initial pressure in pounds per square inch,
p_2 = absolute terminal pressure in pounds per square inch,
L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;

(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;

(3.) Opposite any diameter of pipe will now be found the discharge in cubic feet per hour at atmospheric pressure; and

(4.) Opposite any desired discharge will also be found the required diameter of pipe.

Price of the Computers, in Cloth Case, 6½ x 8 inches, $5 Each, Net.

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Coal and Ashes Conveying.

Every manufacturing and power plant should have a quick and economical equipment--a Link-Belt installation—that pays for itself in a short time by reason of the all-round superiority that marks its design and operation.

Illustration shows ashes elevator enclosed in dust-proof casing, installed for Crucible Steel Co., Jersey City, N. J.

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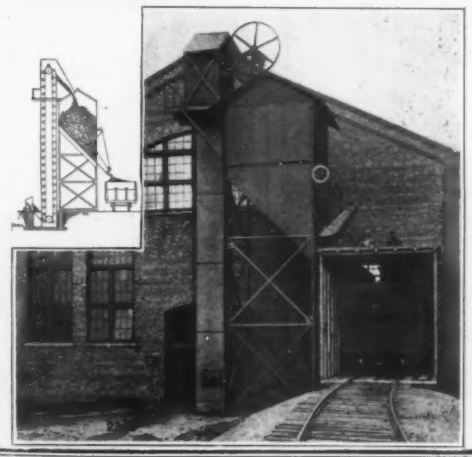

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With an Appendix of Decided Cases.
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CENTURY PATTERN.

Mueller Service Clamps are made in two styles, single strap or Century Pattern for ordinary pressure and small taps, and double strap or Improved National Pattern for excessive pressure and large taps. The boss or tapping surface of each clamp is very heavy, allowing threads of full length to be tapped. These clamps are cast with a rib which gives them extra strength to resist the strain of tightening on the pipe. Made either galvanized or plain and for any pipe size up to 12-inch. Each clamp is thoroughly inspected, bears the Mueller trade mark, and is **unconditionally guaranteed.**

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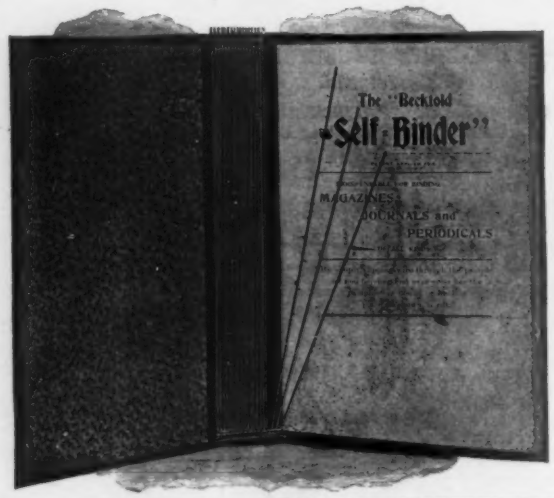

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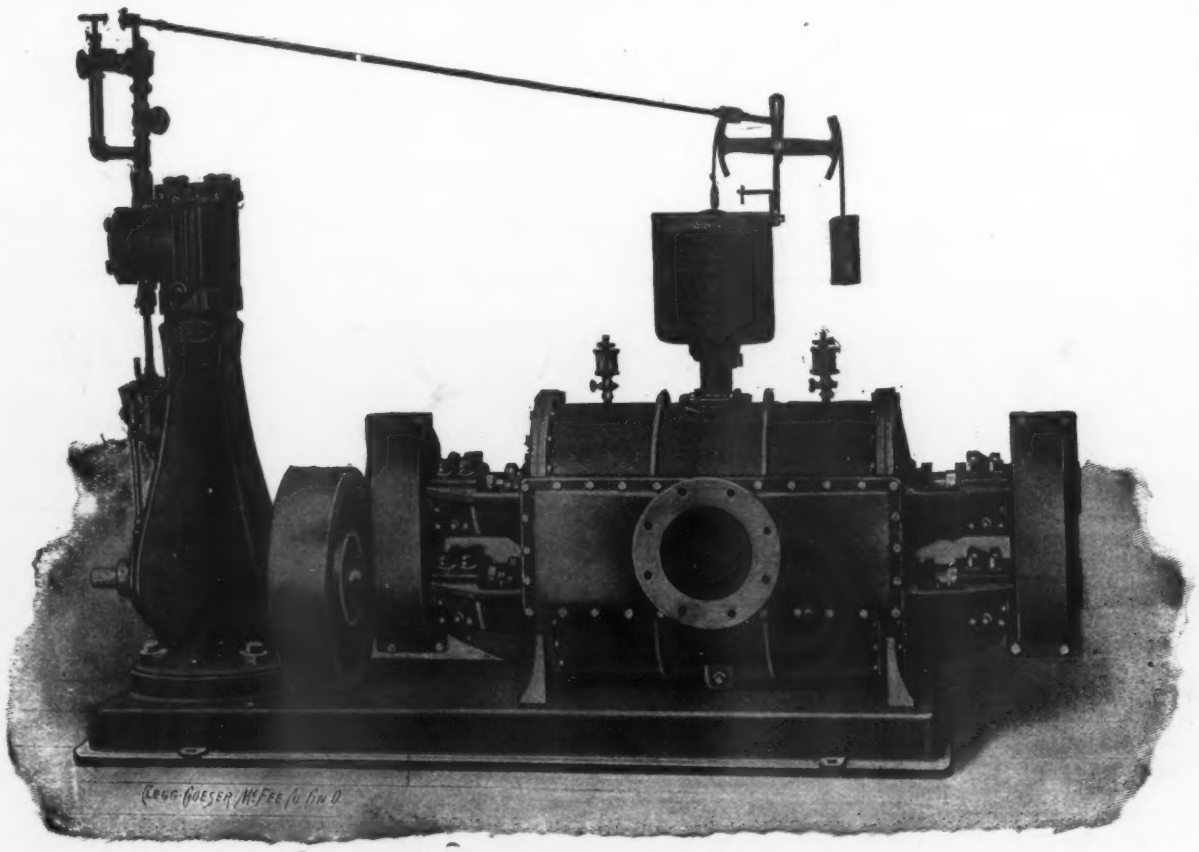

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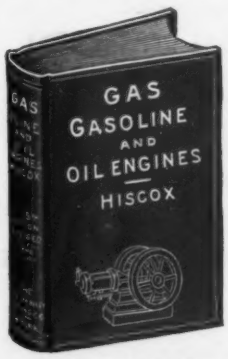

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GAS ENGINES,
With Instructions for Care and Working of the Same,
By G. LIECKFELD, C.E.
Translated with Permission of the Author,
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Gas Engineer's Pocket-book, —BY— HENRY O'CONNOR,
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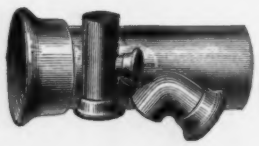

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Four Roll Troughing Idler
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Possess greater efficiency, consume less power, and the belts last much longer than when any other type of roll is employed.
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NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

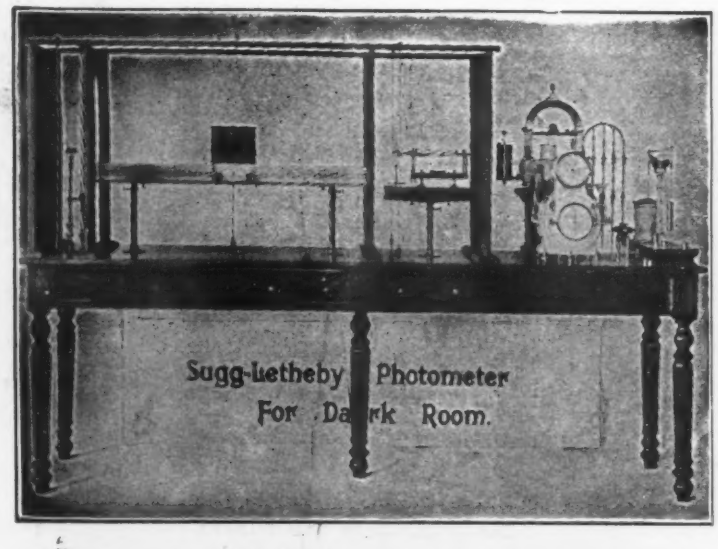
AUGUST, 1906.

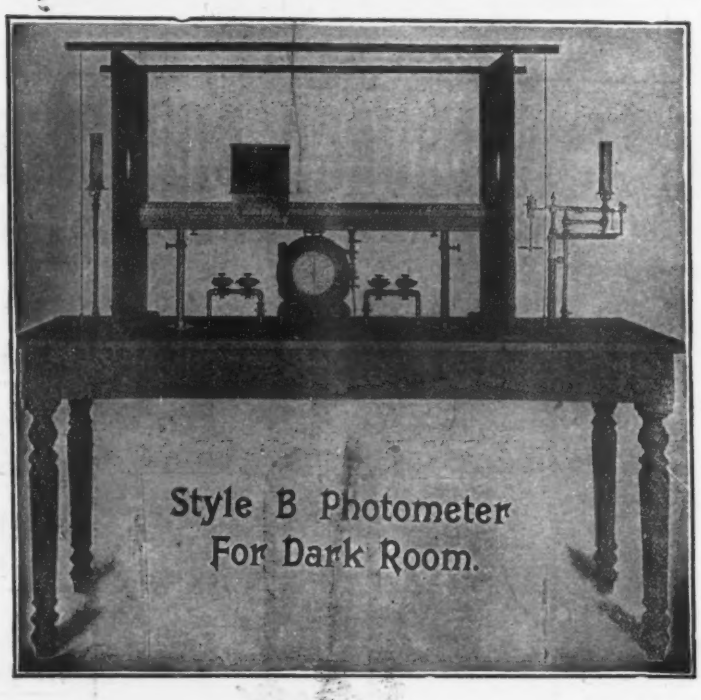
Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.
Wed.	1	1.50 AM	4.00 AM
Thu.	2	2 50	4.00
Fri.	3	No L.	No L.
Sat.	4	No L. FM	No L.
Sun.	5	No L.	No L.
Mon.	6	7.40 PM	9.40 PM
Tue.	7	7.40	10.10
Wed.	8	7.40	10.40
Thu.	9	7.40	11.10
Fri.	10	7.40	11.40
Sat.	11	7.40 LQ	12.10 AM
Sun.	12	7.30	12.40
Mon.	13	7.30	1.20
Tue.	14	7.30	2.00
Wed.	15	7.30	2.50
Thu.	16	7.30	4.10
Fri.	17	7.30	4.10
Sat.	18	7.30	4.10
Sun	19	7.20 NM	4.20
Mon.	20	7.20	4.20
Tue.	21	7.20	4.20
Wed.	22	7.20	4.20
Thu.	23	7.20	4.20
Fri.	24	8.40	4.20
Sat.	25	9.20	4.20
Sun.	26	10.00 FQ	4.20
Mon.	27	10.50	4.20
Tue.	28	11.40	4.20
Wed.	29	12.40 AM	4.20
Thu.	30	1.40	4 20
Fri.	31	2.50	4.20

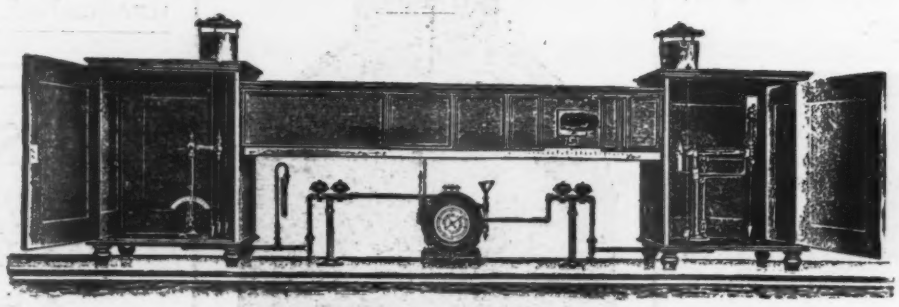
TOTAL HOURS DURING 1906.

By Table No. 1.

	Hrs.Min.
January	223.40
February	190.40
March	192.10
April	167.00
May	152.20
June	142.10
July	150.20
August	157.40
September	170.00
October	185.10
November	201.40
December	214.00
Total, yr.	2146.50







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

AUGUST, 1906.

Day of Week.	Table No. 2. NEW YORK CITY. All Night Lighting. Date.	Light P. M.	Extinguish. A.M.
Wed.	1	7.10	3.30
Thu.	2	7.10	3.30
Fri.	3	7.10	3.30
Sat.	4	7.10	3.30
Sun.	5	7.10	3.30
Mon.	6	7.10	3.45
Tue.	7	7.10	3.45
Wed.	8	7.10	3.45
Thu.	9	7.10	3.45
Fri.	10	7.10	3.45
Sat.	11	7.10	3.45
Sun.	12	7.10	3.45
Mon.	13	6.55	4.00
Tue.	14	6.55	4.00
Wed.	15	6.55	4.00
Thu.	16	6.55	4.00
Fri.	17	6.55	4.00
Sat.	18	6.55	4.00
Sun.	19	6.55	4.00
Mon.	20	6.45	4.10
Tue.	21	6.45	4.10
Wed.	22	6.45	4.10
Thu.	23	6.45	4.10
Fri.	24	6.45	4.10
Sat.	25	6.45	4.10
Sun.	26	6.45	4.10
Mon.	27	6.30	4.20
Tue.	28	6.30	4.20
Wed.	29	6.30	4.20
Thu.	30	6.30	4.20
Fri.	31	6 30	4.20

TOTAL HOURS DURING 1906.

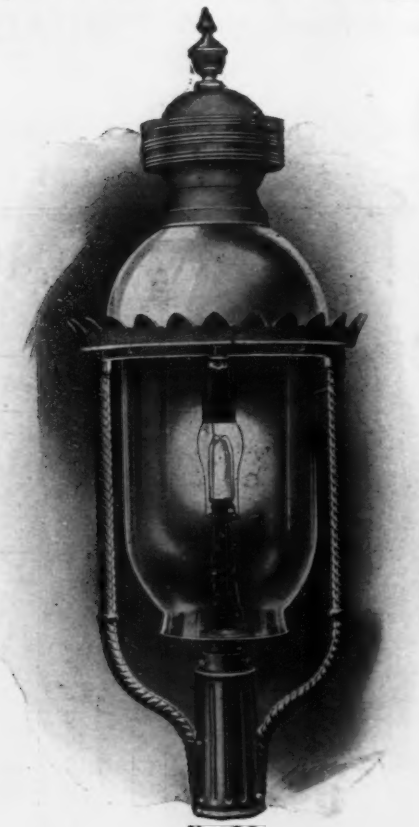
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street.
BOSTON, 820 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
CHICAGO, 218 La Salle Street.
SAN FRANCISCO, 512 Oak Street.

WELSBACH STREET LIGHTING COMPANY

....OF AMERICA....



No. 36.

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Which includes its specially DESIGNED and PATENTED BURNER for PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

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PRICE, EACH, COMPLETE, WITH SHADE, FRINGE, MANTLE AND CHIMNEY, $14. PER DOZ., $150. DISCOUNT, 50 PER CT.

Standard Length, 30 inches.
The New No. 7 Welsbach Dining Room Fixture, when ordered, will be sent complete, as follows:

1 No. 7 Harp Fixture and Brass Crown finished in Brushed Brass.
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1 No. 4 Pilot By-pass.
1 No. 4197 Mantle — Intensive Brand.
1 No. 306 Chimney (air hole).
1 Fourteen-inch GREEN Art Glass Shade, with six-inch Green Beaded Fringe.

VARIATIONS.

Finished in oxidized copper, oxidized brass, etc., 25 cents extra.

Shades in Ruby and Green--Ruby, Amber and other colors, without extra charge.

Special colors require a few days extra time to fill orders.

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PARTIAL LIST OF PLACES:

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Waterbury, Conn.
Manchester, N. H.
Allentown, Pa.
Omaha, Neb.
Muskegon, Mich.
Nazareth, Pa. (2d contract).
Lewiston, Pa.
Greenville, Tex.
New York, Cent. Un. (3d contract).
Jefferson City, Mo.
Peekskill, N. Y. (2d contract).
Waterville, Me.
Washington, D. C. (3d contract).

TOTAL SETS TO JULY 1, 1906, - - - - - 618
TOTAL DAILY CAPACITY TO JULY 1, 1906, 488,930,000 CUBIC FEET.

The United Gas Improvement Company,

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Established 1858. Incorporated 1890.
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In General Use in the United States and Canada.
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Modern Coal Gas Benches,

With either Horizontal or Vertical Retorts, Half-Depth and Full-Depth Recuperative Furnaces.

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STANDARD BENCH IRONWORK.

Linings for Water Gas Apparatus, High Grade Fire Brick of All Shapes and Sizes, Ground Fire Clay, Ground Fire Brick in Bulk or in Barrels.

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HALF AND FULL DEPTH AND FREE FIRING BENCHES,

All styles of which we have in operation, equipped with the BEST of LATEST IMPROVEMENTS, proving our claim for SUPERIOR QUALITY and EFFICIENCY.

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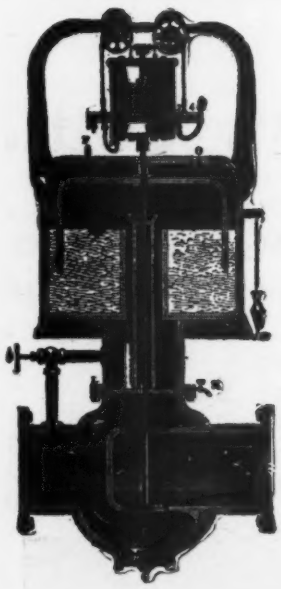

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Automatic, Balance, High Pressure and Service Governors,

Roots Improved Gas Exhausters,

Iron Sponge, Purifying Material for Gas Purification, Jones Jet Photometers, Pressure Registers, etc.,

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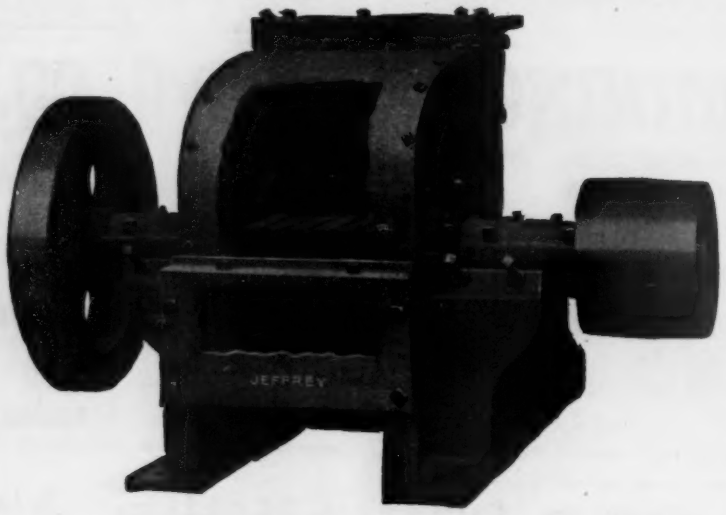

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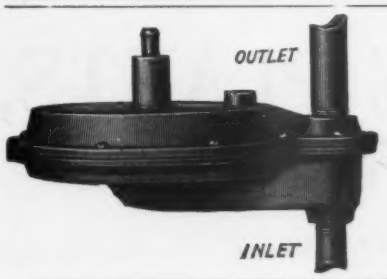

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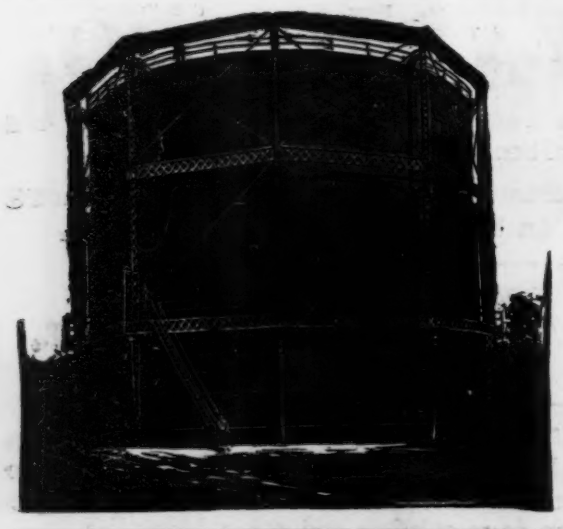

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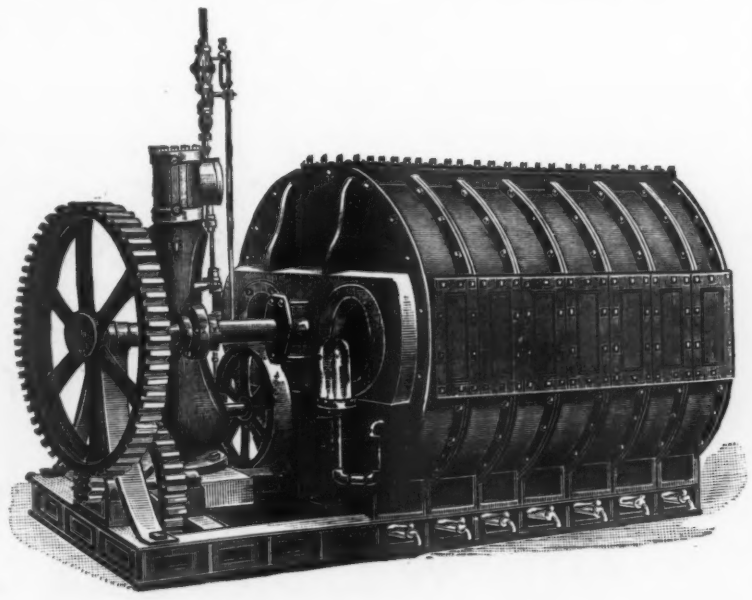

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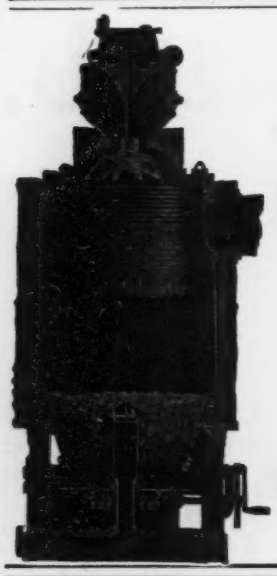

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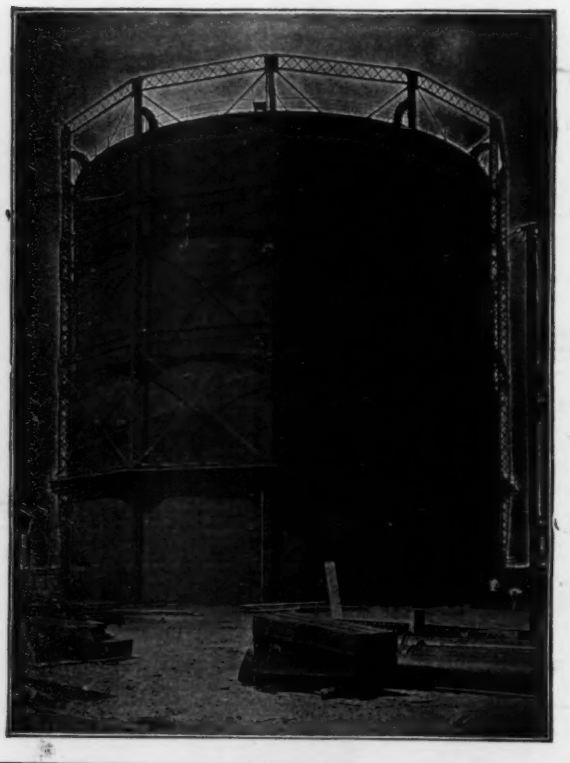

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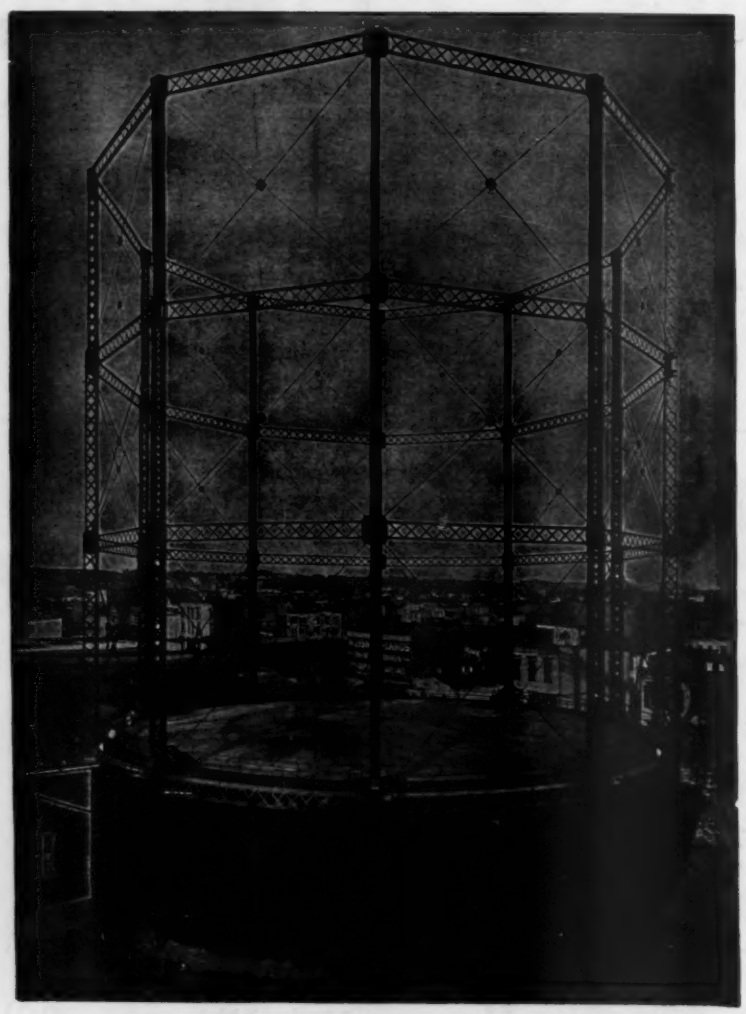

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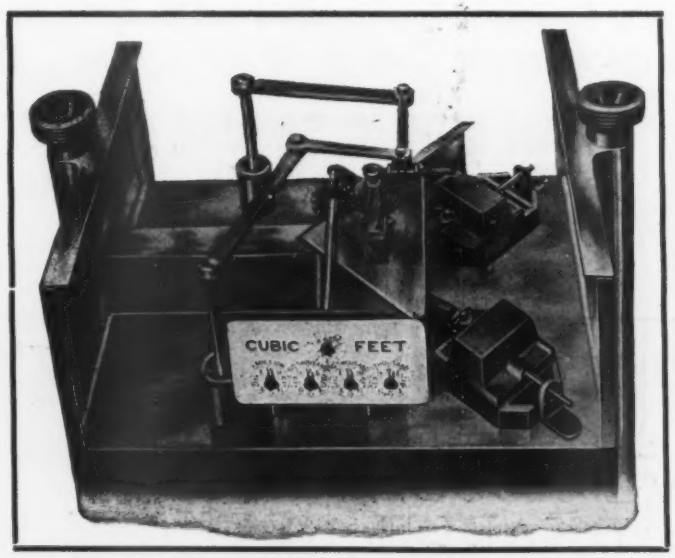

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